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THESIS

AN EXAMINATION OF THE NAVY'S FUTURE NAVAL CAPABILITY TECHNOLOGY TRANSITION PROCESS

by

Robert E. McGahern

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Thesis Advisor:	Keith Snider
Second Reader:	Bernard Ulozas

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13. ABSTRACT (maximum 200 words)

The ability to transition technology developments to operational systems is of great importance to the Department of the Navy (DoN). One way to achieve increased transitions is to operate more efficiently – more "like a business." Over the years significant programmatic and policy changes have been introduced in the DoN. One of these changes was the initiation of a new science and technology (S&T) transition process for delivering new capabilities in a more focused manner -- the Future Naval Capability (FNC) process.

This thesis examines the FNC technology transition process from a business process perspective. A number of common business parameters are researched and used for comparison to the FNC Process. The goals and objectives of the FNC Process are documented and feedback is obtained from the stakeholder community. Although the FNC Process is new, and remains a work-in-progress, the results of this thesis reveal frustration and concern from all stakeholder communities regarding continued difficulties with the process for delivering new capabilities to the warfighter. In comparing FNC Process parameters to those in the commercial sector this research identifies areas where the FNC operations differ from the private sector. In those areas where useful comparisons can be made the FNC metrics fall short. To realize the increased transitions desired, fundamental changes are still needed.

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AN EXAMINATION OF THE NAVY'S FUTURE NAVAL CAPABILITY TECHNOLOGY TRANSITION PROCESS

Robert E. McGahern
Civilian, Naval Air Systems Command, United States Navy
B.E., State University of New York, Stony Brook, 1980

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Author: Robert E. McGahern

Approved by: Keith F. Snider
Thesis Advisor

Bernard J. Ulozas
Co-Advisor

Phil DePoy
Director, Wayne E. Meyer Institute of Systems Engineering

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ACRONYMS AND ABBREVIATIONS

ACMC	Assistant Commandant of the Marine Corps
ACTD	Advanced Concept Technology Demonstration
AO	Autonomous Operations (FNC)
ASN(RDA)	Assistant Secretary of the Navy for Research, Development and Acquisition
ASW	Antisubmarine Warfare
ATD	Advanced Technology Demonstration
BA1	Budget Activity 1 (Basic Research)
BA2	Budget Activity 2 (Applied Research)
BA3	Budget Activity 3 (Advanced Technology Development)
BUMED	Bureau of Medicine
BUORD	Bureau of Ordnance
BUPERS	Bureau of Naval Personnel
CCI	Command Capability Issue
CFFC	Combined Fleet Forces Command
CM	Capable Manpower (FNC)
CMC	Commandant of the Marine Corps
CNET	Chief of Naval Education and Training
CNO	Chief of Naval Operations
CNR	Chief of Naval Research
CoCOM	Combatant Commander
CONOPS	Concepts of Operations
CTO	Commercial Transition Office
CTTO	Commercial Technology Transition Officer
DASN	Deputy Assistant Secretary of the Navy
DDR&E	Deputy Director for Research & Engineering
DoD	Department of Defense
DoN	Department of the Navy
DPG	Defense Planning Guidance
DPRM	Direct Reporting Program Manager
DSS	Decision Support System (early FNC)
DTO	Defense Technology Objectives
DUSD	Deputy Undersecretary of Defense
D&I	Discovery & Invention
EC	Enabling Capability
ExLOG	Expeditionary Logistics (early FNC)
E&D	Exploitation & Delivery

FAD	Fleet Advanced Demonstration
FCB	Functional Capability Boards
F/F	Fleet/Force
FFRDC	Federally Funded Research and Development Centers
FNC	Future Naval Capability
FYDP	Future Years Defense Program
GAO	General Accounting Office
GPRA	Government Performance and Results Act
HQMC	Headquarters, Marine Corps
IAR	Independent Applied Research
ID	Information Distribution (early FNC)
IFO	International Field Office
IG	Inspector General
ILIR	In-house Laboratory Independent Research
IPA	Interagency Personnel Agreement
IPT	Integrated Product Team
IWAR	Integrated Warfare Analysis and Requirements
JCIDS	Joint Capabilities Integration and Development System
KSA	Knowledge Superiority & Assurance (FNC)
LASW	Littoral Antisubmarine Warfare (FNC)
MC	Marine Corps
MCCDC	Marine Corps Combat Development Command
MCP	Mission Capability Package
MD	Missile Defense (FNC)
MOE	Measures of Effectiveness
MOU	Memoranda of Understanding
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NETC	Naval Education and Training Command
NIST	National Institute of Standards and Technology
NPR	National Performance Review
NPV	Net Present Value
NRAC	Naval Research Advisory Committee
NRE	Naval Research Enterprise

NRL	Naval Research Laboratory
NRSA	Naval Research Science Advisor
NTTO	Naval Technology Transition Office
NWDC	Naval Warfare Development Command
OCNR	Office of the Chief of Naval Research
OMCM	Organic Mine Countermeasures (FNC)
ONI	Office of Naval Intelligence
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
OSD	Office of the Secretary of Defense
PAT	Process Action Team
PBAS	Program Budget Accounting System
PBD	Program Budget Decision
PE	Program Element
PEO	Program Executive Officer
PM	Program Manager
PMA	Program Manager, Aviation
PMS	Program Manager, Ships
POA&M	Plan of Action and Milestones
POM	Program Objectives Memorandum
PP	Platform Protection (early FNC)
PPBS	Planning, Programming, and Budgeting System
POR	Program of Record
PR	Procurement Requisition
QDR	Quadrennial Defense Review
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluations
ROI	Return on Investment
RTT	Rapid Technology Transition
S&T	Science and Technology
SECDEF	Secretary of Defense
SECNAV	Secretary of the Navy
SES	Senior Executive Service
SPAWAR	Space and Naval Warfare Command
SPP	Sponsor Program Proposal
SSG	Strategic Studies Group
SUBTECH	Submarine Technology
SYSCOM	Systems Command
TCS	Time Critical Strike (FNC)

TOA	Total Obligation Authority
TOC	Total Ownership Cost (FNC)
TOG	Technology Oversight Group
TRL	Technology Readiness Level
TTA	Technology Transition Agreement
TTM	Time-to-Market
T&E	Test & Evaluation
UARC	University Affiliated Research Center
USMC	United States Marine Corps
USN	United States Navy
VCNO	Vice Chief of Naval Operations
VCNR	Vice Chief of Naval Research
WP	Warfighter Protection (FNC)
WWII	World War II

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I. INTRODUCTION

A. BACKGROUND

Due to limited financial resources a number of agencies within the government have been exploring ways to operate more efficiently for many years. The Internal Revenue Service (IRS), the National Aeronautics and Space Administration (NASA)[1] and the U.S. Postal Service are examples of three such government agencies which have pursued, in a very public and visible manner, efficiency reforms in the way they conduct their business operations.

The Department of Defense (DoD) has also been aggressively pursuing fundamental changes to the way it conducts its business operations. The recent Defense Transformation Act for the 21st Century is possibly the most sweeping reform of the Defense Department since the Goldwater-Nichols Act of 1986. Business reform initiatives, in accordance with the Secretary of Defense's (SECDEF) transformation mandate, are being implemented within the military services. As SECDEF Donald H. Rumsfeld commented in an editorial column, "the fact is that the transformation of our military capabilities depends on the transformation of the way the Defense Department operates."[2] The driving force behind the continued desire to operate more efficiently, beyond the obligation of being judicious stewards of taxpayer dollars, was the realization that such actions free up limited resources needed for other desired uses.

To realize increased business operating efficiencies the government has sought to model some of the methods of the commercial sector. If such commercial practices were translated to government business operations it seemed reasonable to expect to free-up additional resources through increased operating efficiencies realized by taking

1 NASA, in particular, has been in the public spotlight regarding efforts in changing how they do business in their struggle to keep a national space program alive. For additional material on initiatives to make the government more "businesslike" under President Clinton refer to Chapter 9 of Butrica, A. J. (2003). Single Stage to Orbit: Politics, Space Technology, and the Quest for Reusable Rocketry. Baltimore: The Johns Hopkins University Press. See also McCurdy, H. E. (2003). Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program. Baltimore: The Johns Hopkins University Press and McCurdy, H. E. (1994). Inside NASA: High Technology and Organizational Change in the U.S. Space Program. Baltimore: The Johns Hopkins University Press . These efforts, which focused on doing more with less, cutting waste and bureaucratic red tape, are considered by many to have been failures.

2 Rumsfeld, D. H. (2003, May 22). Defense for the 21st Century. The Washington Post, p. A35.

advantage of lessons learned from the commercial sector. One of the areas where there is a desire recapitalize investments is in the transitioning of advanced technology to the military operational community.

1. Department of the Navy Initiatives

The ability to transition new technology developments successfully into operational systems in a reasonable timeframe has been, and continues to be, of critical importance to the Department of the Navy (DoN). As mentioned above, the SECDEF has articulated a mandate to transform our military services into a more responsive, mobile and expeditionary force to defend our citizens. This guidance is being aggressively implemented within the DoN. The realization of the transformational changes desired will likely require the transition of new Science and Technology (S&T) developments to the operational community in a more efficient and rapid manner.

Over the last few years significant programmatic and policy changes have been implemented in the DoN's S&T program. These changes are attempts to change the way the Navy conducts the "business" of scientific research, the development of new technologies and the transitioning of those technologies from a laboratory environment into an operational military system. One of the changes implemented was the initiation of a new S&T process – the Future Naval Capability process – for delivering technology to the operational community in a more focused and accelerated manner.

B. PURPOSE

The purpose of this research was to examine the effect that attempting to operate "like a business" has had on the implementation of the Future Naval Capability process. This thesis examines business concepts, such as the use of business models and group decision dynamics, to determine if the FNC Process accurately approximates the business processes from the commercial sector. A focus on the "business environment" of the FNC Process will focus the analysis of issues encountered when attempting to transition products to the operational community.

The objectives of the various participants in the process will be analyzed, and the difficulties they report of the transition process will be discussed. Finally, an assessment will be made regarding whether or not the process metrics were sufficient to facilitate the transition of technology to the operational community in a more accelerated manner (as desired). The goal of this research was to provide a greater understanding of the issues involved, and suggest changes that might benefit future technology transition efforts.

C. RESEARCH QUESTIONS

The primary research question for this thesis was:

> To what extent is the Future Naval Capability S&T business environment conducive to an acceleration of technology transition?

In order to answer this question it was necessary to obtain background information on business methods, the Navy's S&T Program, the Navy's new FNC technology transition process and an understanding of the environment within which the FNC Process operated. To obtain this exploratory background information it was necessary to first answer the following questions:

- What triggered these changes to the execution of the DoN S&T Program?
- What is the history of the FNC Process?
- What FNC technology transition metrics exist?
- To which areas is the technology being transitioned?
- How do the FNC Integrated Product Teams operate?
- What changes to the FNC technology transition process have occurred?
- What transition issues have arisen from the FNC Process?
- How do other DoD/DoN transition processes relate to the FNC Process?
- To what extent are current transition efforts an improvement over past efforts?

D. BENEFITS OF STUDY

This study contributes to a greater awareness of the issues encountered when attempting to transition science and technology projects from the laboratory to an operational system in an accelerated manner. Lessons learned will be captured from the

Navy's FNC technology transition process and the defense business environment that surrounds that transition process. These lessons represent very real obstacles to the Navy's ability to transition technology in a rapid manner and arise from conflicting priorities of the various participating organizations. A clear understanding of the difficult and critically important issues encountered when attempting to transition new technology projects to the fleet in an accelerated manner is essential if resolution of those transition problems is to be achieved. This thesis provides practical information and useful feedback regarding the implementation of the FNC technology transition process for future researchers and those involved in DoN policy decisions.

In addition to DoD guidance, commercial business processes and performance models, DoN S&T and FNC literature, the analysis provided here was based on other relevant sources, including a number of senior DoD, DoN and commercial personnel as well as individuals who participated in the FNC Process and so were intimately aware of the process mechanics, advantages and shortfalls. The results of this research are intended to provide positive tangible benefit to the DoN's S&T program as a reference to be consulted when exploring lessons learned and when planning further changes to the Navy's technology transition processes.

E. SCOPE

This thesis covers the FNC subcomponent of the DoN S&T Program only. This thesis makes no attempt to assess the success or failure of specific FNC's nor of individual projects funded through an FNC Integrated Product Team. The period of relevance for this thesis covers what I refer to as the "first implementation phase" of the FNC Process which formally started[3] with FY02 funding. Data collected spanned the approximate period of November 1998 through September 2003. Those FNC Process changes which occurred in late 2003 were considered to be part of the "second implementation phase" of the FNC Process and were not addressed in the analysis[4].

[3] This happened when funding resources were provided.

[4] One change, for example, was the separation of two FNC's, Capable Manpower and Warfighter Protection, from the rest.

F. METHODOLGY

An extensive literature review of relevant information was conducted. Examples of such information includes; DoD guidance, directives, instructions, books, magazine and newspaper articles, and other relevant library information resources regarding military transformation efforts, business reform processes and the current DoD "business" operating environment. A review of previous research on technology transfer experiences was also undertaken. This review included the use and effectiveness of business models, group theory and decision-making dynamics, and the use of teaming arrangements in the technology transition process.

A series of questions, designed to provide insight into the FNC technology transition process, were prepared. To answer the questions raised data were collected from a number of independent sources. Personal interviews of high level civilian (government and commercial) and military leaders, DoN community stakeholders and FNC technology transition process participants were conducted. In addition, an electronic survey was electronically mailed to FNC participants from each of the four major S&T stakeholder communities. This data was analyzed to evaluate the extent to which the FNC Process approximated industry business methods as well as to determine if the DoN S&T "business environment" was conducive to promoting technology transitions at an accelerated pace.

G. ORGANIZATION OF STUDY

The research presented in this thesis is organized as follows:

Chapter II (Literature Review) provides background information on the events that have led to our current business environment within the DoN. A number of important business concepts such as business models, group decision-making and collective action behavior dynamics are presented in detail. Also presented are a summary of transition experiences found in the literature.

Chapter III (DoN Science and Technology Program) is an extension of the literature review and provides the reader with an overview of the DoN's Science and Technology (S&T) Program. This chapter, compiled essentially from public DoN "marketing" material, describes the Navy's S&T leadership reporting structure, the DoN S&T Program and its subcomponents.

Chapter IV (Future Naval Capabilities) is a further extension of the literature review but focuses on a major subcomponent of the DoN S&T Program, the Future Naval Capability process. This chapter presents a detailed description and chronology of the Future Naval Capability technology transition process and documents its implementation.

Chapter V (Data Collection and Analysis) presents and analyzes the data collected to assess whether the DoN has been able to operate more "like a business" and whether our DoN business environment has facilitated the acceleration of technology transition to the warfighter. The analysis of this chapter is based on feedback provided by DoN S&T "stakeholder" representatives who participated in the Future Naval Capability process and returned an electronic survey on the Future Naval Capability process. The analysis also draws from personal interviews of high level representatives from representatives within the government (military and civilian) and industry responsible for technology development and the transitioning of technology to operational systems.

Chapter VI (Conclusions and Recommendations) presents a series of conclusions and recommendations based on the analysis and experiences of the stakeholder communities directly involved with the FNC Process. A number of the important technology transition issues are summarized and the recommendations made to stimulate debate and suggest alternate approaches to achieving the technology transition results desired.

Appendix A (FNC Survey Responses) provides the raw data used for the analysis in Chapter V. These are the S&T community[5] stakeholder responses to the electronic survey on the FNC Process.

[5] The four S&T stakeholder communities are 1) S&T, 2) OPNAV, 3) Acquisition and 4) Fleet/Force.

Appendix B (Business Models) provides information on the revenue generation schemes of many common business models used by the commercial sector. This appendix shows the variety of revenue-generation options possible.

Appendix C (Acquisition Transition Issues) provides one specific example of a program that has experienced, and continues to experience, many of the technology transition issues examined by this thesis. Resolution of the difficult issues span will require collaboration across the spectrum of DoN stakeholder community's.

Appendix D (Measures of Effectiveness) provides a summary of metrics used to measure the effectiveness of a defense "business" operation that were uncovered during the literature search portion of this research.

Appendix E (Congress) provides a very brief overview of the role that Congress plays in appropriating the operating revenue for government organizations. The Congress plays an increasingly important role in the technology transition process and this role needs to be acknowledged and understood.

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II. LITERATURE REVIEW

A. INTRODUCTION

This chapter provides background information on a number of subject areas in order to lay the foundation for topics raised throughout the remainder of this thesis. With respect to the broad issue of technology transition, the issue regarding whether the government can – or even if it should – operate in a more business-like manner was researched in the open literature and shown to be a highly complex matter. As this topic was explored it was found to be a highly convoluted mix of issues and concepts that require careful examination in order to resolve the relevance and interdependencies among many of the important topics explored.

This chapter starts out by presenting some examples of guidance provided by the government for operating more efficiently and more effectively – more “like a business.” The guidance cited spans a substantial period and concludes with relatively recent “transformational” objectives provided by the Secretary of Defense.

The concept of a “business environment” is introduced next and a number of typical business measures are presented. These measures are used as fundamental metrics through which comparisons will be made between the commercial and defense business “market” sectors.

An overview of business models is also presented. “Models” of business operations were found to be in use throughout the commercial sector. The use and development of accurate models of business operations are considered critical to successful business operations. This section explains what business models are and how they are used by the business community. Because of their importance to understanding business operations an appendix to this thesis provides additional information on the revenue schemes used by various business models.

A comparison of the civilian and military business “markets” is then explored in order to illustrate a few key differences between the two types of business markets. Some very important comparisons between government and business operating principles

are explored in order understand what principles have been used in the past and to assess better whether or not the government can be reasonably compared to a business operation or, as an example will show, under what conditions have successful operations been demonstrated in the past.

Because of its fundamental importance to basic business operational principles and a number of the issues uncovered later during the research of this thesis, there is a section which explores group dynamics and group decision-making in depth. Many of the issues explored in both the commercial and military sectors were fundamentally based on principles of group dynamics. Accordingly, any resolution of these issues will also require a understanding of the group dynamics involved.

A section which summarizes the technology transition experiences of others is also included in this chapter. The experiences of corporate attempts to transition technology is directly relevant to the "businesslike" core of this thesis. A number of innovative approaches which have been used are described.

This chapter concludes with a brief summary of the major points of the chapter before moving on to providing a description of the Department of the Navy's Science and Technology Program, in Chapter III.

B. BACKGROUND

The desire for the federal government to operate more efficiently has been a consistent goal for a large number of years. This objective is not simply a recent emphasis but has been a remarkably consistent theme articulated by both the executive and legislative branches of our government. Over the past fifty years there have been numerous "experiments" in ways to transform government agencies and department operations into more efficient, more effective organizations.

The premise behind this thesis is that the government is deliberately attempting to mimic business practices because those in policy-making positions believe it makes perfect sense to do so. There will be, in effect, a sufficient return on investment in doing do. Part of the rationale is that businesses are presumed to operate in a more efficient

manner, and are thought to be more responsive to customer needs,[6] two attributes universally desired within the government.

This desire to operate "like a business" has not been limited to the larger departments of the government, such as the Department of Defense, but has been equally pursued across the many diverse components of federal, state and local governments. The underlying goal is to respond to a perceived need for an increasing amount of financial resources to respond to taxpayer demands. Raising taxes is one method to secure these increased resources. Wringing more out of our current operations ("doing more with less"), through increased efficiencies, is clearly another method to obtain additional needed resources. Along this line of reasoning the fundamental assumption is that the implementation of new, more efficient, more effective, transitional organizational administrative processes will provide a means for these departments and agencies to break from the shackles of the traditional, highly bureaucratic, and financially wasteful, administrative processes and thereby free-up taxpayer monies for use in more urgent and needed programs. As would be expected some of these experiments have been regarded as more successful than others but all have explored varying approaches to operate our government agencies in a more judicious manner.

The premise behind the reform initiatives is that requiring our government agencies to operate more "like a business" will cause them to be more competitive[7] and more responsive to changing market conditions. Such behavior would make them more efficient, more effective, and save taxpayer money.[8]

C. GOVERNMENT GUIDANCE

An awareness of the government's ability to operate effectively came about as a consequence of this country's response to WWII. From this national emergency came a

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6 If they did not, the logic goes, they would soon be out of business. There is validity behind this based on this sentiment being expressed just this way by the President of a small manufacturing company who was interviewed. His interview comments are included later in this chapter.

7 For the Navy, the "competition" might realistically be considered to be the other Defense Agencies and Services – for example, DAPRA, the Air Force and Army. It is these agencies that compete against the Navy for financial resource allocations, ultimately decided upon by the Congress.

8 In this case a fundamental business tenet of "making a profit" is equated with that of organizational efficiency and "saving money." However, making money and saving money are not equivalent.

large number of scientific and manufacturing innovations, industry partnerships and experimental alliances forged in support of the high priority civilian and military activities which were being conducted in the defense of this nation. The level of manufacturing productivity attained, as well as the technological advancements achieved, were truly extraordinary and provided this nation with first-hand evidence of the possibilities.

Following WWII – indeed up to current times – there is substantial evidence of continued attempts to operate government agencies and organizations in a more effective, more efficient, manner. Examples of such attempts are found at all levels of U.S. government operation (local, state and federal) as well as internationally.

The Clinton Administration placed a heavy emphasis on "reinventing" the government. The National Performance Review's (NPR) goals were about "fundamentally changing the way government does business."[9] The four primary tenets outlined by the NPR were:

- Put customers first by regularly asking them how they view government services, what problems they encounter and how they would like services improved.
- Make agencies compete for customer business.
- Turn government monopolies into more business like enterprises.
- Shift some federal functions from old-style bureaucracies to market mechanisms.

With respect to the Defense Department, the "market-focus" of the National Performance Review had very little substance to it. The "market mechanisms" refer to the issue of "governance" but the specific market mechanisms discussed were not germane to defense. They addressed more general social problems such as environmental protection, worker safety, health and public housing.

One of the observations the NPR made referred to the difficulties the government organizations were having in dealing with Congress. Although no solutions were suggested as a result of the NPR, the final report observed:

[9] Report of the National Performance Review. (1993). p. 43.

> Many agencies will be unable to set clear measurable goals until Congress simplifies their responsibilities. Programs are bound by multiple, often conflicting, legislative objectives. The complex politics of passing enabling legislation and then negotiating annual appropriations forces some programs to be all things to all people.[10]

An economist observed the drive to operate the government more like a business was based on the competitive forces of the private markets:

> The intention is to force public bureaucracies to be governed by the same competitive forces that make private markets socially beneficial.[11]

In various forums William Perry[12] has expressed his opinion that the defense business environment has fundamentally changed and that "the Defense Department must ride on the shoulders of our commercial industry" and "give up our unique buying practices and employ best commercial practices."[13] In essence, although Defense R&D might remain in government control for critical defense needs the military's "buying practices" should be based on private sector models.

Much of the history behind the military and business changes implemented by William Perry are discussed in a book published after his service as SECDEF ended.[14] A reading of his book provides surprisingly little insight into the reasoning behind the changes implemented during his service as SECDEF. With respect to a discussion of business concepts and the goals and objectives he desired through his acquisition reform initiatives, Mr. Perry's book falls short in providing amplifying information beyond linking much of what had to be done to a need for acquisition reform. In his book Mr. Perry (1999) provides only brief background information regarding the long time it took to implement the acquisition reform changes. The changes which were eventually implemented are actually attributed to the recommendations of the Packard Commission

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10 Ibid. p 74.

11 Sclar (2000), p. 3.

12 William Perry served as Secretary of Defense from January, 1994 to January, 1997. Many of the significant acquisition reform changes were implemented by the Department of Defense while William Perry served as Secretary of Defense.

13 Perry, W. J. (1998, February 23). Defense Must Open the Commercial Door, LA Times.

14 Carter, A. B. and Perry, W. J. (1999)

report, *A Quest for Excellence*, released in April, 1986[15]. The Packard Commission's final report called for a number of changes, including a revolution in defense management. The revolution in defense management consisted of three distinct parts:

1. RMA – A Revolution in Military Affairs. The focus of this was on an Army simulation emphasis and their "Force 21" concept.
2. RBA – A Revolution in Business Affairs.
3. RPM – A Revolution in Personnel Management.

Mr. Perry states the revolution in business affairs was inspired "by the marked increase in managerial efficiency of US industry over the last two decades."[16] The use of Integrated Product and Process Development (IPPD) teams was one of the new DoD procedures introduced under RBA.[17] As Mr. Perry describes them, these [IPPD] teams:

> … have been used by industry for about a decade with great effectiveness. They bring together the various members of the design and production team at an early stage of the design process to consider simultaneously what is to be made and how it is to be made, allowing for cost-effective tradeoffs in design specification and production techniques.

These business reform initiatives are fundamentally about cost. The high cost of supporting the current force structure, the long acquisition cycles and the continued mismatch between fiscal resource realities and operational force structure requirements are the driving forces behind these changes and emphasize the need for transformation. When doing a survey of the government's defense acquisition and procurement systems, plenty of examples of cost problems can be found.[18] As just one example, in 2000 the Congressional Budget Office (CBO) had estimated the Navy would require roughly $17 billion more *each year* for fiscal years 2001 through 2005 than was being planned[19].

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15 Information on President Ronald Reagan's Blue Ribbon Commission on Defense (1986), also known as the Packard Commission, can be found at the National Defense University (NDU) library website, URL = http://www.ndu.edu/library/pbrc/pbrc.html, retrieved June 2004.

16 Carter, A. B. and Perry, W. J. (1999). p. 210.

17 Integrated Product Teams are discussed in more detail, as an implementation of a group theory construct, later in this chapter.

18 The problem, of course, is wider than the Defense Department. Any number of sources—such as the GAO, the CRC, and others—can provide reports and studies that identify cost problems.

19 Budgeting for Naval Forces: Structuring Tomorrow's Navy at Today's Funding Level, Congressional Budget Office, October 2000

1. Transformation Planning Guidance

Throughout the current administration a very clear case has been made in the open press, by the President and the Secretary of Defense, for the need to 'transform' our defense organizations. The urgency of these changes has been emphasized by the terrorist attacks launched in September 2001 against U.S. citizens. The Transformation Planning Guidance,[20] signed by Secretary of Defense Donald H. Rumsfeld, states a need to transform existing practices to sound business practices as one of three areas of the DOD transformational efforts. This document mentions initiatives are already under way as a result of Defense Planning Guidance (DPG). The objectives of the DPG are incorporated within the Defense Transformation Act, congressional legislation designed to provide the Defense Department increased flexibility to manage its personnel better.

In an editorial outlining some of the reasons for transforming the Defense Department the SECDEF describes a number of management problems plaguing the DoD. He describes personnel problems that have resulted in a large number (in excess of 300,000) of on-duty military personnel and contractors filling positions that should be filled by civilian personnel. The transformation initiatives are aimed at actions needed to manage a civilian workforce that is responsive and adaptable and mentions they are addressing most of the problems they have the power to fix, such as "implementing a new business management structure"[21] and calls upon Congress to acknowledge its responsibility in the transformation process and take the legislative actions that are needed to reach these goals

One of the priorities is a reform of the acquisition process in order to reduce the acquisition cycle time and align acquisition with a new capabilities-based resource allocation process built around joint operating concepts.

2. Technology Assessment

Because the issues are so complex, the investment costs are so high, and the development timeframes so long, there is a critical need within the government for an

[20] DOD, Transformation Planning Guidance, April 2003.

[21] Rumsfeld, D. H. (2003, July 18). Why Defense Must Change, Washington Post, p. A19.

unbiased technical advisory function. Congress needs such a service, for the legislative decisions it is called upon to decide, as does the DoN for the highly technical tradeoffs which are absolutely critical for cost effective operations. Incredibly, such a service is not provided today to either organization which leaves both vulnerable to poor and costly decisions as a result of a confusing tangle of special-interest analysis. This deficiency has been raised in the past. In a study of the weapons development and acquisition process, Fox (1974) concluded "Congress needs substantially more analytical support than it is now receiving."[22]

The literature provides evidence that the role of scientific technical advisor has traditionally been a controversial, difficult and often unappreciated one. Politically, the advisory science role has been tolerated, and only reluctantly. Dr. Vannevar Bush's[23] influential report[24] on the need for a civilian scientific agency to address urgent needs was accepted by President Harry Truman but not implemented in the manner and with the urgency recommended. Although the importance of the issues was too important to overlook the recommendations were implemented in a different manner and Vannevar Bush's influence in Washington declined.

In 1976 President Nixon, "furious with advice he didn't want, unceremoniously fired his science advisor," which, in turn, caused Congress to create the Office of Science and Technology Policy (OSTP) by law.[25] The elimination of the Office of Technology Assessment (OTA) in 1995 left Congress without an organizational tool to tap into for the expert scientific and technological advice needed for effective legislative decision-making. This deficiency has become increasingly critical, as more and more of the decisions faced by Congress and society require judgments based on highly specialized technical information. The negative ramifications of this action are increasingly more evident as Congress debates serious policy decisions on highly technical matters ranging from anthrax and stem cell research to weapons inspection criteria.

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[22] Fox (1974). p. 457.

[23] Dr. Vannevar Bush was Head of the Office of Scientific Research and Development during WW II.

[24] Bush, V. (1946). Science – the Endless Frontier. Washington DC: U.S. Government Printing Office.

[25] Kelly, H. (2003, August 12). No Substitute for Sound Science. Washington Post. p. A13.

The Navy, too, has historically resisted any independent scientific advisory role. William McBride describes the difficulties the Navy has encountered in its struggles with technological change, one small aspect of which was the early formation of an "ineffective and peripheral Navy Consulting Board."[26]

The technical assessment function continues to be a issue for the Navy. In much more recent independent reviews of portions the Navy's S&T investment portfolio, the need for system analysis to support the program goals and provide a reliable assessment of technology options was found to be an often repeated finding of the Naval Studies Board (NSB).[27]

Like the General Accounting Office and the Congressional Research Service, the National Academy of Sciences is an organization which does play an important role in providing Congress and the DoN, through the Naval Studies Board, with independent assessments of technical issues and programs. Like all of the outside assessment organizations, their role is necessarily limited and their reviews are not typically conducted in an urgent and timely manner. The DoN needs a more vibrant, proactive system analysis and technical assessment advisory capability in order to make the policy and resource decisions that are needed.

D. BUSINESS MEASURES

In conducting this research a number of factors that influence how an organization conducts their business operations were found. Those that appear to play a significant role for government business operations are included in this section.

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[26] McBride (2000). p. 93.

[27] The lack of quantitative system analysis is a continued repeat finding by the Naval Studies Board. Some of the reports which cite this shortfall include (1) Naval Studies Board. (1999). 1999 Assessment of the Office of Naval Research's Air and Surface Weapons Technology Program. Washington D.C.: National Academy Press.; (2) Naval Studies Board. (2000). 2000 Assessment of the Office of Naval Research's Marine Corps Science and Technology Program. Washington D.C.: National Academy Press.; (3) Naval Studies Board. (2000). An Assessment of Undersea Weapons Science and Technology Program. Washington D.C.: National Academy Press.; (4) Naval Studies Board. (2000). Network-Centric Naval Forces: A Transition Strategy for Enhancing Operational Capabilities. Washington D.C.: National Academy Press.; (5) Naval Studies Board. (2001). 2001 Assessment of the Office of Naval Research's Aircraft Technology Program. Washington D.C.: National Academy Press. This continued lack of system analysis can drastically limit the DoN's ability to make informed investment and technical decisions.

1. The Business Environment

The business environment is typically reflected through a number of indicators which provide potential investors a glimpse into the state of the health of the market of interest. Specific environmental indicators will vary by market, but examples of typical generic environmental indicators would include; the strength of the market economy, the degree of political stability, the legal and regulatory environment, taxation laws and policies, competition policies, the availability and quality of the labor market, the quality of infrastructure, and the markets openness to investment.

2. Market Performance Indicators

For the commercial sector there are a large number and variety of performance metrics and economic indicators to guide investment decisions. For example, it is very common for individuals and businesses to refer to a number of Wall Street stock market indexes for an indication of performance. Some of the more common indexes are:

- **The Dow Jones stock indexes**. The Dow Jones Industrial Average (DJIA) index serves as a broad measure of the entire U.S. market. The DJIA includes such diverse industries as financial services, technology, retail, entertainment and consumer goods. The Dow Jones Transportation (DJTA) and Utilities (DJUA) Averages include only transportation and utilities stocks.[28]
- **NASDAQ**. NASDAQ lists a large number of "category-defining" companies including technology, retail, communications, financial services, transportation, media and biotechnology companies.[29]
- **S&P 500**. The Standard and Poor's 500 (S&P 500) is an index made up of five hundred stocks, each of which is selected for liquidity, size, and industry. The S&P 500 is a common benchmark for the overall market, and is frequently used as the standard of comparison for investment performance.
- **New York Stock Exchange (NYSE) Composite Index**. The NYSE Composite Index measures the performance of all common stocks listed on the NYSE. This index consists of more than 2,000 U.S. and non-U.S. stocks and is a measure of the changes in aggregate market value of all NYSE-listed common stocks.[30]

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28 The Dow Jones Indexes website. http://www.djindexes.com/, retrieved June 2004.

29 The NASDAQ website. http://www.nasdaq.com/about/overview.stm, retrieved June 2004.

30 The NYSE website, http://www.nyse.com/marketinfo/composite_desc.shtml, retrieved June 2004.

- **American Stock Exchange composite index**. The American Stock Exchange (Amex) Composite Index is made up of all listed equities on the exchange.[31]
- **Russell 2000 index**. This index measures the performance of 2,000 small-cap (small companies just starting to grow) stocks.[32]

As a subset to any of these market indices there will be more specific market indicators including, for example, declining issues, advancing issues, and trading volume. At the individual company level, where stock certificates are sold to individual investors, the sale price of a share of stock is another metric indicator.

3. Revenue

Revenue is the heart and soul of all business operations. For commercial business operations the source of revenue is the customer. For government business operations the revenue flow is more complicated because of the number of organizations that become involved – the revenue stream is not supplied through a simple business-customer relationship. For government operations, although all revenue ultimately comes from the taxpayer, the actual financial appropriations for any government organization will come from the Congress and not directly from the taxpayer. As such, congressional representatives function as a proxy on behalf of their constituents, a subset of the total population of U.S. taxpayers. As a consequence, the taxpayer is not necessarily – or even typically – considered to be the "customer" in all cases, which greatly complicates the actions and accountability of government 'business' operations.

Within DoD the Navy portion of President's Budget (PRESBUD) Research, Development, Test and Evaluation (RDT&E) funds[33] flow from the Under Secretary of Defense (USD) for Acquisition, Technology, and Logistics (AT&L) to the DoD Comptroller. The DoD Comptroller provides a Program Budget Accounting System (PBAS) allocation Navy-wide. The responsible office for Navy-wide RDT&E is ONR.

[31] American Stock Exchange, http://www.amex.com/?href=/atamex/news/press/sn_XAX_010504.htm, retrieved June 2004.

[32] Ameritrade On-line, http://www.ameritrade.com/educationv2/fhtml/stockmarket/russell.fhtml, retrieved June 2004.

[33] For the Defense Department, the Science and Technology (S&T) account is a subset of the governments Research, Development, Test and Evaluation (RDT&E) account.

The DoN PBAS allocations are disbursed to the Navy claimants who then initiate funding requests and documents such as project directives, military interdepartmental procurement requests, procurements, contracts and grants. In addition, Congress typically makes other changes to the appropriated defense accounts as well. For example, there can be congressional "plus-ups" which would be considered separate from the PRESBUD as well as "undistributed reductions"[34] and "rescissions."[35]

4. Customer

The most important aspect of any business venture is a clear understanding of the customer. Business models will make assumptions based on an understanding of customer needs and buying behavior. Without a clear understanding of who the customer is a business will not be able to make accurate assumptions of behavior and the model will not be a reliable approximation of the consumer-business dynamics. For example, the customer is generally considered to be the source of a business's primary revenue stream. Business operations are focused on meeting customer needs throughout the life-cycle of the product or service. Business operations are concerned with retaining existing customers as well as attracting new customers for future business growth through expanded revenue streams.

5. Return on Investment

Return on Investment (ROI) is a common financial measure based on historical data. Viewed as such, ROI is a backward-looking metric that measures how well an investment has performed over time. ROI metrics will not predict how investments will perform in the future or how to improve business results for greater future returns. Typical ROI calculations will require the organization to identify the total financial benefit received from an investment (technology project) while subtracting out the total investment required to develop, produce, and deliver that program to the customer.

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[34] Financial reductions made to current FY accounts.

[35] Financial reductions made to a previous FY account.

The commercial sector uses ROI as one investment decision criteria. Dr. Simon Ramo, a former Vice Chairman of the Board and Chairman of the Executive Committee of TRW, summarizes the use of ROI from a business perspective:

> In some important, needed areas of technological endeavor now dependent on government financing, adequate investment funds will not be forthcoming from the private sector for the straightforward reason that the anticipated return on the investment, when compared with the risk, is not satisfactory. The financial yield will not be seen as meeting the requirements of the private money market where superior investment alternatives are to be found.[36]

A typical ROI formulation would look like:

ROI = (Total Benefit - Total Costs) / (Total Costs)

In this formulation total benefits would include revenue earned (or saved) by the organization in addition to any other line items that would add, directly or indirectly, to the organization's bottom line. In such cases, the "total benefits" term might simply refer to the cumulative cash flow (revenue stream) of an investment over time. The "total costs" term would include such things as program development costs, administration costs, lost investment opportunity costs, organizational overhead, materials, facilities, cost of coordination, marketing costs, etc., and any other costs incurred.

Another way that ROI is viewed is by comparing the net income to the organizations assets. In this case the ROI equation would look like:

ROI = (Net Income) / (Value of Assets)

There are concerns that ROI measures tend to overstate the expected (or even experienced) rate of return (ROR) on the investments under consideration. These concerns arise because it is actually extremely difficult to measure all of the costs associated with any program and even harder to isolate the financial benefits from any

[36] Ramo (1980). p. 72.

one specific program. The degree to which ROI overstates the economic value of the investment may depend on a number of factors:[37]

- The length of project life. The longer the project continues, the larger the overstatement tends to be.
- Capitalization policy. The smaller the fraction of total investment capitalized in the books, the greater the overstatement is.
- The rate at which depreciation is taken on the books. Depreciation rates that are faster than straight-line basis rates produce higher ROI calculations.
- The lag between investment outlays and the recoupment of the outlays from cash inflows. The greater the time lag, the greater the degree of overstatement.
- The growth rate of new investment. Faster growing companies will have lower ROIs.

Estimates of reasonable ROIs for technology development projects is difficult. Norman Augustine, a former Chief Executive Officer for the Lockheed Martin Corporation, suggested 20% was a reasonable return:

> Numerous studies have shown that taxpayer investment in fundamental research yields double-digit returns; indeed, most suggest a payoff of at least 20 percent – not a bad deal in a time when your money-market fund is lucky to pull in 1 percent.[38]

This 20 percent figure roughly matches that of some other investments, even some reported venture capital investments. Although for venture capital firms there are usually serious issues with releasing investment return information because the funds are, in many cases, too new to measure returns accurately. Even so, some do provide return data. For example, Carlyle Venture Partners II L.P., a fund managed by the Carlyle Group, reported an annual return of 20.83 percent as of June 30, 2003.[39]

Acceptable ROI figures will vary by investor. The 20 percent ROI figures mentioned above are significantly higher than the 5 and 6 percent returns seen by some drug companies:

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[37] The ROI factors listed are based on information available at the "Value Based Management.net" website, URL = http://www.valuebasedmanagement.net/methods_roi.html, retrieved April 2004. Multiple management texts and internet sources provide similar definitions for ROI.

[38] Augustine, N.R. (2003, August 8). Supporting Science and Security. The Washington Post, p. A17.

[39] Johnston, N. (2003, July 20). Funds Secrecy Under Attack. The Washington Post, p. D3.

> The Bain consultants say drug companies are earning only a 5% return on their investment in finding new drugs, below levels typically demanded by equities investors. Licensing products from other companies, which was a profitable strategy until recently, is now bringing only a 6% return on investment, they say.[40]

Other "financial ratios" are also referenced in the literature and treated as ROI figures at times. Since "ROI" does not appear to have a single, universally understood definition other financial metrics are sometimes used in its place. "Return on Invested Capital," "Return on Capital Employed," "Return on Total Assets," "Return on Equity," and "Return on Net Worth," all have similar, but different, meanings and might be referred to as a "return on investment" metric. As a result, ROI estimates can be confusing. When using ROI metrics it is important to ensure the definition being used is clearly stated.[41]

6. Net Present Value

Companies will calculate the "net present value" (NPV) for projects when preparing their corporate budgets. NPV compares the value of a project (in today's dollars) to the value contribution of that project in the future. To make this projection assumptions are made regarding the anticipated inflation rate as well as the minimum required rate of return for the investment.

By doing the NPV calculation a company can determine whether the total present value (PV) of a project's expected future cash flows will be sufficient to justify the initial costs today. If the NPV of a prospective project is expected to be positive (i.e., money will be made from the project) the project would be an acceptable investment whereas if the NPV is shown to be negative (i.e., money would be lost due to this project) then the project would be an unacceptable investment and should be rejected. In many cases internally competing projects are compared, via NPV calculations, in order for the

[40] Landers, P. (2003, December 8). Cost of Developing a New Drug Increases to About $1.7 Billion. The Wall Street Journal. p. A9.

[41] Based on ROI information at the "Solution Matrix, Ltd." website, URL = http://www.solutionmatrix.com/roigo.html, retrieved April 2004.

company to decide which of the competing projects are expected to have a sufficient corporate 'value' to merit funding.

When calculating NPV the present value of revenue inflows are subtracted from the present value of revenue outflows. The result is a "net" value estimate for the project at the current time and in current dollars.[42]

The NPV is calculated as the present value of the project's cash inflows minus the present value of the project's cash outflows. This relationship is expressed by the following formula:[43]

$$NPV = \sum_{t=0}^{T} \frac{CF_t}{(1+r)^t} = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_T}{(1+r)^T}$$

Figure 1. Net Present Value (NPV) formulation

where:

CF_t = the cash flow at time t and
r = the cost of capital.

The cost of capital, also referred to as the discount rate, is the minimum rate of return which would be necessary for a project to be considered as an attractive investment. This rate is determined by corporate executives.

NPV measurement is widely used for making investment decisions. One criticism of the NPV calculation is that it does not account for flexibility and uncertainty after the project decision has been made. Some prefer to use a "Real Options" valuation to account for this shortfall.[44]

7. Real Options

The Real Options method captures the value of managerial flexibility in being able to adapt decisions in response to unexpected market developments. Companies create shareholder value by identifying, managing and exercising real options associated

42 Investopedia.com website, http://www.investopedia.com/terms/n/npv.asp, retrieved June 2004.

43 Prentice-Hall website, http://www.prenhall.com/divisions/bp/app/cfldemo/CB/NetPresentValue.html, retrieved June 2004.

44 Value Based Management.net website, http://www.valuebasedmanagement.net/methods_npv.html, retrieved June 2004.

with their investment portfolio. The Real Options method applies financial options theory to help quantify the "value" of management flexibility and leverage uncertainty in a changing world. When viewed as such, an organizations business strategy is more like a series of financial options than a series of static cash flows.[45]

As a result, in valuations that involve significant future flexibility or where there is significant uncertainty or future revenue flows are close to the break-even point, such as long-term strategic scenario's, flexibility can become a major source of corporate value. In these situations the value of the option ("Real Options") needs to be taken into consideration.

The following variables determine the value of having an option:

- Project duration
- Degree of uncertainty
- Cost of acquiring the option
- Potential cashflows lost compared to the full upfront commitment
- Risk-free interest rate
- Expected present value of future cashflows

By introducing these factors into the business decision-making process, the Real Options method allows corporate decision-makers to leverage uncertainty and limit their risk. In most cases the NPV and Real Options calculations are both used in corporate decisions. For projects with a lot of uncertainty, the Real Options valuation estimate is often of equal order or greater than the PV for out-year returns. This combination can change the "sign" of the NPV result, and thus change the decision to invest.

8. Time-to-Market

Time-to-Market (TTM) is a measure of how quickly an organization can bring a product from conception to sales. From a business perspective rapid product development processes (fast TTM timeframes) are more profitable than slower product

[45] Treating strategic investments as financial options was brought forward by Timothy Luehrman. See 1) Luehrman, T.A., (1998, July-August). Investment Opportunities as Real Options: Getting Started on the Numbers, Harvard Business Review and Luehrman, T.A., (1998, September-October). Strategy as a Portfolio of Real Options. Harvard Business Review.

development processes (slow TTM timeframes). Rapid TTM processes are positive contributing factors for the success of an organization for the following reasons:

- The competitive advantage for getting a product to market sooner
- Premium prices are obtainable early in a product's life cycle
- Faster breakeven on development investment
- There is a lower financial risk
- The product has a longer market life cycle
- There should be larger sales volume
- Greater overall profits and, therefore, a higher ROI

The key process requirements to realize a rapid TTM would be:

- A vision of what is technically possible
- A clear understanding of customer needs
- Stability in product requirements or specifications
- An optimized product development process
- An accurate business model
- Availability of resources (human, natural, etc) to support the project
- Competent personnel
- Early involvement and rapid staffing build-up to support the parallel design of product and process
- Virtual product development including digital assembly modeling and early analysis and simulation to minimize time consuming physical mock-ups and testing, and
- Design reuse and standardization to minimize costs.

It is of interest to note the connection between ROI and TTM. An organization's TTM will affect the ROI realized due to the time correlation between the two metrics (hence the phase, "time is money").

9. Supply Chains

A Supply Chain consists of those organizations and operations that a business will use to produce and deliver a final product or service from the supplier's supplier to the customer's customer.[46] Supply chain management typically includes managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer. Supply chain management addresses a host of various complex interdependencies. These interdependencies create an "extended enterprise" that reaches far beyond the factory door. For the Navy this extended enterprise includes the (small and large business) manufacturers as well as the various Navy Laboratory and Warfare Centers (the Naval Research Enterprise, or NRE).

In a business environment there has been a sharp focus on supply chain management and operations in order to reduce product costs. This focus, in turn, is requiring a much greater responsiveness out of the supply chain partners in order to remain competitive and maintain sustainable business operations. Desired business supply chain operations would include increased customer responsiveness and service, reduced inventory levels and procurement costs, and an improvement of the production and distribution assets.

The benefits that can be obtained from careful management of the supply chain have been demonstrated by companies like Wal-Mart and Dell Corporation. The Navy's ability to manage its supply chain is a challenge due to the scope of the Navy and Marine Corps "business operations." Such a wide scope of operations arguably creates greater uncertainties in our supply and demand estimates. Other factors such as the impact of competition (local and global), shorter product and technology life cycles, and the increasing use of international distribution and logistics partnerships have led to higher risks being experienced by our partners within the supply chain. The literature says it is necessary to understand the risks being assumed by the various components of the supply chain.

46 Definition taken from the Supply Chain Councils' FAQ website, URL = http://www.supply-chain.org/Resources/faq.htm, retrieved 15 July 2003.

10. Trust

Another important aspect of the business environment, but one easily overlooked, concerns the issue of "trust." Trust is more than an ethical trait which is usually dealt with on a personal level, such as between individuals in a personal relationship. It is also applicable to business relationships and corporate actions. In business, just as it is true for personal relationships, trust is a matter of making – and keeping – commitments, of being dependable, responsible and truthful. Just as in personal relationships a loss of trust can seriously erode business relationships and become obstacles to future activities. The opposite characteristics of trust would be selfishness, lying, cynicism, etc. These types of characteristics will foster resentment, disloyalty and distrust. When viewed from a business perspective:

> Trust forms the foundation, or the dynamic precondition, for any free enterprise system. What constitutes that freedom is not only the right to make promises (to buy, to produce, to sell, to hire and pay, to give one's labor or one's expertise), but, just as important, the responsibility for keeping promises, following through on one's offers, making good on one's commitments. The individual entrepreneur, like the giant corporation, depends on trust – including self-trust – to function in the business world.[47]

Indeed, the importance of trust was specifically cited as a significant factor required for the effective implementation of the IPT concept by a major defense contractor:

> In any defense acquisition program, cooperation and trust between Government and contractor personnel are the two essential elements of a successful business partnership.[48]

The literature mentions that although many businesses will have turned away from the old "command-and-control" organizational model, they end up reverting back to that model because employees and managers do not know how to practice "office politics" within a culture of trust. Such behavior has deep ramifications for the organization at all levels (within the organization) and across outside boundaries (throughout the supply chain).

[47] Solomon & Flores (2001). p. 11.

[48] Kao (2000), p 53.

Unless an environment of trust is developed and nurtured the potential effectiveness of the business operation will be necessarily constrained. People within the organization, and throughout the businesses supply chain, will do their jobs but the atmosphere will not be conducive for them to offer the ideas, creativity and enthusiasm needed by a thriving, growing organization. The repercussions of such a negative business environment will not only affect the employees within the organization but it will also adversely impact business relationships within the supply chain and, ultimately, with the customers as well.

11. Making Progress and Embracing Change

Historically there have been enormous difficulties in documenting and embracing the process of technological change. The technical interrelationships of projects funded, and records of results achieved, have been so difficult to document that accurate reconstructions of how technologies actually develop and change our operations are very difficult to find. There have been, however, some notable attempts to understand technology development and its relationship to research and development made. At least two major studies were conducted. The first, sponsored by DoD, was called Project Hindsight[49] and the second was a study funded by NSF called Technology in Retrospect and Critical Events in Science (TRACES).[50] Project Hindsight attempted to trace the contributions of basic research on specific weapons programs while TRACES looked over a longer time horizon and focused more on the commercial sector, making the two studies very hard to compare. These studies looked at different aspects of tracing technology transitions but both also faced considerable criticism.[51]

Attempts to quantify technological change in strictly economic terms, such as is done in the work of Jacob Schmookler, have also faced criticism and difficulties based on disagreements over some of the assumptions imposed."[52] As such, attempts to present a

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49 Project Hindsight (1969), Office of the Director of Defense Research and Engineering.

50 TRACES (1968), IIT Research Institute for NSF.

51 Kreilkamp, K. (1971). Hindsight and the Real World of Science Policy, Science Studies 1. p. 43-66.

52 Sanders, B.D. (1966). Commentary on Invention and Economic Growth, Idea 10, pp. 587-608.

reasonably accurate interpretation of technological change continue to experience great difficulty due to the serpentine nature of technological advances, as well as the diversity and complexity of such changes.

A number of researchers have reported a tendency for radical innovations to be developed outside the sectors most affected. Edward Constant II[53] provides an excellent discussion of the issues involved regarding the development of the turbojet engine and shows this innovative technological development was the culmination of more than two centuries of turbine development from water turbines and turbine water pumps through turbosuperchargers. In his discussion Constant references researchers who had conducted similar case studies related to other technical fields.[54]

The National Bureau of Economic Research has also reported on the great diversity in the development paths of radical innovations. Their report also argues that economic growth from improvements in efficiency, productivity and product performance depend heavily on detailed, painstaking, incremental improvements in existing technologies (rather than the introduction of a completely new "disruptive" technology).[55]

For the naval community, William McBride[56] explores the technological and strategic paradigms that are inextricably linked for the Navy. His study looked at how the naval profession addressed technological change. He found that within the professional naval society the participants are bound by a strong traditional warrior ethos. In such a society new technology can be destabilizing to the traditional way of "doing the business" of warfare. Some historians have described how traditional warrior ethos have been powerful filters against the adoption of new military technologies.

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53 Constant (1980).

54 Constant (1980) references two other sources which are of interest; (1) Jewkes, J., Sawers, D., and Stillerman, R., (1958). The Sources of Invention, (London: Norton) and (2) Hamberg, D., (1963). Invention and the Industrial Laboratory, Journal of Political Economy 71 pp. 95-115.

55 National Bureau of Economic Research, (1962). The Rate and Direction of Inventive Activity: Economic and Social Factors. (Princeton: Princeton University Press).

56 McBride (2000)

The difficulties with change are traced back to the concept of a paradigm by Thomas S. Kuhn. Analogous to the concept of "puzzle solving" that Thomas Kuhn indicated was necessary for the advancement of normal science, Constant discusses the concept of traditional technology development as being the "improvement of the accepted tradition or its application under new or more stringent conditions."[57] He contends this type of behavior is how technological communities achieve progress. Constant further observes such developments are typically only achieved at great cost and through enormous effort from those communities.

In his study Edwin Layton noted the importance of acts of creative "transformation" in transferring knowledge from scientific to technological social systems. Layton's views were that science and technology are separate but similar and interacting social systems:

> The passage of information from one community to the other often involves extensive reformulation and acts of creative insight. This requires men who are in some sense members of both communities. These intermediaries might be called 'engineer-scientists' or 'scientists-engineers,' depending on whether their primary identification is with engineering or with science. Such men play a very important role as channels of communication between the communities of science and technology.[58]

There can be great obstacles to embracing a new technology or new solution because the old approaches are not abandoned easily. The final decision regarding whether or not to invest in the adoption of a new technology may essentially be considered a "paradigm shift" in certain cases due to the difficulty in reaching that conclusion. The decision, nevertheless, will ultimately depend on a number of factors including expected costs, efficiency and risks. Other, non-obvious and – frustrating the scientific community – non-technical, factors will play an important role in these decisions as well. Consideration regarding the ease with which the new system can be explained and understood, its compatibility with its intended environment and the extent

[57] Constant (1980). p. 10.

[58] Layton, E. (1972) Mirror-Image Twins: The Communities of Science and Technology in Nineteenth-Century America, in George Daniels, ed., Nineteenth-Century American Science: A Reappraisal (Evanston: Northwestern University Press) p. 227.

to which it can be easily tried will all be factors in the final decision about whether a new technology will be accepted or rejected.[59]

As has been shown, the complexity of modern technological systems requires long lead times, massive capitalization and extensive planning. In a rebuttal to the Navy's requirements-driven technology development process (such as the FNC Process), Constant has observed:

> Virtually all product development and most production are done in anticipation of demand rather than in response to it.[60]

12. Effectiveness and Efficiency

In many respects the issue of successful business operations boils down to an assessment of an organization's effectiveness in performing its tasks and coordinating its efforts with others outside of its authority. There has been a host of research conducted on measuring the improvement of an organizations' effectiveness and efficiency. Although they are quite different these two terms are confused and are sometimes used almost interchangeably. For a commercial endeavor the qualitative measures of productivity have been shown to be all based the concept of efficiency. As has been pointed out:

> It is not satisfactory to measure production of goods or services by dollars spent for them (even when inflation is taken into account) and not recognize the improvements in the goods and services being produced.[61]

Some of the research uncovered in this area is summarized as follows:

- In 1963, Quinn and Mueller identified the need for long-range planning to determine the technologies relevant to a company's business goals, planning technology transfer, and top management attitudes that foster the development of new technologies[62].

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[59] Constant (1980). p 16.

[60] Constant (1980). p 30.

[61] Ramo (1980). p. 64.

[62] Quinn, J. B. and Mueller, J. A. (1963, January-February). Transferring Research Results to Operations. Harvard Business Review. pp. 49-66.

- In 1977, Roy Rothwell compared nine studies of industrial innovation. Common success factors for industrial innovation among the nine studies were: good communication, clear identification of market needs, good planning and management techniques, innovation as a corporate-wide task, and efficient R&D.[63]
- In 1988, Lowell Steele posed a series of relevant questions when evaluating a technical operation. The types of questions he asked were: Is adherence to project goals emphasized? Are market inputs sought and used? Are technical priorities made in light of resource priorities? Are manufacturing requirements well integrated? Is technology a persistent and effective advocate for innovation?[64]
- In 1996, Robert Szakonyi reviewed the measures of R&D effectiveness over the previous 30 years and identified 10 activities that were consistently used over that period as metrics for R&D effectiveness. Those activities were: 1) selecting R&D, 2) planning and managing projects, 3) generating new product ideas, 4) maintaining the quality of the R&D process and methods, 5) having a positive environment for motivating technical people, 6) establishing cross-disciplinary teams, 7) coordinating R&D and marketing, 8) the ability to transfer technology to manufacturing, 9) fostering collaboration between R&D and finance and 10) linking R&D to business planning.[65]
- In 2001, Jim Collins reported on the results of a study where his team examined the histories of twenty-eight carefully selected companies to determine what factors were key for the eleven companies that were able to make the leap from "good to great".[66]

In Szakonyi's research it was reported there have been numerous studies which have measured R&D operations but focused on R&D efficiency metrics (i.e., how much time and resources were required to complete an activity) rather than R&D effectiveness.[67] Indeed, many of the business process initiatives being instituted by the government also appear to be aimed at improving the "efficiency" of government

63 Rothwell, R. (1977). The Characteristics of Successful Innovators and Technically Progressive Firms (with some Comments on Innovation Research). R&D Management, 3. pp. 191-206.

64 Steele, L.W. (1988, September-October). Evaluating the Technical Operation. Research Management. pp. 11-18.

65 Szakonyi, R. (1996). Measuring R&D Effectiveness –1. Research Technology Management. pp.27-32.

66 Collins, J. (2001). Good to Great. New York: HarperCollins Publishers Inc.

67 Szakonyi, R. (1996). p 30.

operations (i.e., lowering costs) rather than making those operations more effective. In many cases these business process initiatives implement actions and policies to make the organization operate more efficiently but these same actions actually undermine an organization's operational effectiveness by severely restricting the affected organization's flexibility and, ultimately, its ability to rapidly respond to dynamic market conditions in the timely manner desired. In an effort to make operations more efficient (cost-wise) they have imposed policies that have diminished the effectiveness of our operations and, as a result, have made the affected laboratories less competitive. Such a result is the exact opposite of the original goals and intentions of the actions taken.

A number of different metrics for organizational effectiveness have been proposed over the years. Appendix D provides a listing of some of the measures of effectiveness encountered during this research.

E. BUSINESS MODELS

Business models are planning tools used by company executives to study their business operations. A business model can be viewed as the 'architecture of the revenue' that a business will use in order to capitalize on the 'value' of a technology, product or service. In this way a business model provides a way of studying how a business conducts its operations and how a company can generate revenue. The business model spells out how a company expects to work, how it will make money, and how it will enhance "shareholder" value by describing its role and where it is positioned in the value chain for the product or service it produces.

In most cases any successful business will have thought out and documented a very specific and detailed model of their operations. The business plan outlines all components of a business's operation and assigns qualitative performance metrics to portions of the business plan based on initial assumptions of how the business would nominally perform in steady state.

The company's vision, mission, values, and business plan need to be thought through, written out, communicated, executed and tracked. The discipline of putting the

business plan in writing will facilitate thinking through the important aspects of the business. Doing so carefully and thoroughly allows organizations to identify obstacles and opportunities, determine areas in which additional attention is needed, set performance goals, establish resource and partnership strategies, and identify performance metrics to track. In some cases, however, an organization's business model will not be formally documented or will not be readily available to those outside of the organization.[68]

It might not be unusual for a company to develop a number of separate business models. If a company has several different products different business models may be needed to describe varying approaches to revenue generation, product financing, development and customer delivery mechanisms. In such cases a top-level business plan would exist at the corporate level reflecting the company's overall plan, and separate business models would exist for each major product line. These separate business models would each dovetail into the top-level corporate business strategy and corporate planning.

1. How Business Models are Used

Business models operationally describe a specific product line that supports a company's strategic business plan. Business models are developed in accordance with an organizations vision and mission statement, objectives, and strategies. At a minimum, vision and mission statements should be drafted, published, refreshed and reviewed with all personnel annually. These are important to maintain the focus desired, and to ensure all personnel are working as a team, with full understanding of the company's direction.

The strategic business plan will provide detailed guidance on the preferred company approaches to conducting normal operations, influencing potential investors and ways of acquiring required financing. Prior to the development of a business plan there will have been marketing research done and company executives will have already

[68] This may be for security or for business competition reasons. In such cases an approximation of a business model can usually be estimated by an examination of company actions, corporate literature, instructions, guidance, etc. Even when business models are fully available, because of the competitive nature of business one can expect the most important details of a business model will be considered sensitive and not readily available to those outside of the senior leadership of company or organization.

developed a product or service as well as marketing plans. By the time the business model is completed a company will already have a feasible product or service to offer to a targeted customer who is expected to be willing to purchase that product in some manner (buy, lease, rent).

The thought process to create the business model enables a company to focus on the future as well as the present; provides the mission to accomplish the vision; provides the strategies and initiatives to accomplish the mission, while taking the steps to accomplish the vision. The process enables a company to look three to five years into the future, and lay out the appropriate strategies and initiatives to get there.

One of the uses of a documented business model is to periodically review the company's status and compare the business planning to actual operations. These reviews allow corporate executives to analyze what worked, what didn't, and make changes to the plan to enable greater and quicker strides toward the vision. Regular reviews of the goals and objectives enable the team to re-focus on what was to be accomplished. The review process enables executives to correct actions that had gone off course or came up short; and initiate new ones based on lessons learned, changes in the marketplace, changes in technology, etc. The business model and its review provide the capability and tool for executives to be able to proactively manage the business, rather than "flying-by-the-seat-of-one's-pants" and allowing confusion, chaos, and luck to manage the business.

2. Components of a Business Model

There is some variation regarding the specific components of a business model. This variation can be confusing when comparing business models in one reference to business models from another source. As an example, in an article posted at an Accenture website some of the common characteristics of business models are discussed. In this discussion the authors outline what they feel the various business components to be. They point out a business model can have several parts with some of these part each, in turn, being referred to as a model. Examples of key sub-components of typical business models they mention are: Pricing model, Revenue model, Commerce process model, Internet-enabled commerce relationship, Organizational form and a Value

Proposition. A common thread is that a business model describes what is unique about their company and, more importantly, what differentiates their product offering from those of competitors in the same industry. They defines a business model simply as, "A real business model is the organization's core logic for creating value."[69]

In reviewing 70 companies they report no single model provided a guarantee for financially superior results but they did make an observation that the more successful models appeared to share three characteristics:

1. Their products offered the customer some unique "value." Many times this value proposition was a unique combination of superior product, price and service.
2. They were able to articulate a key product differentiator--something that made their product offering stand out when compared to products offered by their competitors. Very successful models are also able to devise market-entry barriers that protected their revenue streams from being bled-off by competitors.
3. The models were "grounded in reality" and based on accurate assumptions of customer behavior. This point was key as it allowed the organizations to match their product delivery cost structures to their revenue streams.

Other researchers have examined business models and come up with very similar characteristics. Some common attributes of a business model are:

- A value proposition. The value proposition is an estimate of the "value" created for potential customers.
- Market segment. The market segment describes the potential customer sector in detail. The detail will include a description of how the technology will be used and the anticipated revenue generation scheme.
- Value chain. The value chain identifies the business partners required to create, and distribute the product to the customer.
- Cost structure and profit potential. An estimate of the costs and profits based on the potential "value" of the product to the customer and the operating efficiencies of the company's value chain.
- Value Network. Describes the position of the company within an overall competitive network of suppliers and customers. The value network includes direct competitors as well as those companies that provide complementary products to the targeted customer sector.

[69] Linder, J. and Cantrell, S. (2001). "What makes a good business model anyway? Can your's stand the test of change?" URL = http: www.accenture.com. Accessed April, 2003.

- Strategy. Corporate plans that describe how a company plans to gain and maintain market share over their competitors.

3. Public Sector Models

The interest in business models has not been limited to the commercial sector nor is it an area of interest only to the United States. Wassenaar researched Dutch electronic government e-commerce activities from a business perspective and presented it as a governmental value chain model. His particular model incorporated the legislative, administrative and juridical functions of the Dutch government and linked these constitutions to public sector "trading" parties (citizens, etc). It is noteworthy to observe in his paper that some of the issues driving this research appear to be completely analogous to similar issues being expressed here in the US. For example:

> At one side, bureaucratic governmental organizations have to be reengineered and internally broken up in small self-containing flexible units in order to respond to the service needs of their citizens. On the other side, they have to be externally integrated in interdependent networks coordinated by public-private governance.[70]

In his discussion on business models, Wassenaar further observes, "Business models are a very often mentioned, but not a well defined concept in literature. There is a lot of variety in interpretation of this concept." Even so, he also stated the core function of any business model was the delivery of "value" to a customer. Although his research was focused on government e-commerce activities, Wassenaar stated his model was "an effort to transfer business concepts to Electronic Government in the public sector." Wassenaar concluded the application of business model concepts to his government value chain model was indeed useful and remarked that it would be interesting to elaborate the business concept to the field of administrative (resource) management.

4. Defense: Modeling Business Success

Following the establishment of the Defense Acquisition Goals 2000, the Department of Defense has undertaken a number of business reform initiatives and has,

[70] Wassenaar, A (2000, September 6-8). E-Governmental Value Chain Models. 11th International Workshop on database and Expert Systems Applications (DEXA'00). pp. 289-293.

in some cases, established additional goals. For example, DoD convened a study group to help implement a Section 912(c) of the National Defense Authorization Act for Fiscal Year 1998 recommendation to enhance commercial business environment education and training. The DoD study group's experience is summarized in the Department's final report, "The Commercial Business Environment: Accelerating Change through Enterprise Teaming." This group based their work on a business model approach used by 'world–class corporations' to manage and accelerate change within their organization(s). For the DoD the goal was to harness the Department's array of improvement efforts, using the business model to transform the Department into a learning organization and fashion new cross–functional teaming roles. The study group recommended using this model in the acquisition context, then broadening its use beyond acquisition after it had demonstrated some proven successes. The report makes the following statements:

- The Department was engaged in several pilot programs to test one step of the business model, validating its effectiveness in communicating and implementing a vision for improving selected defense projects.
- The Department planned to expand the use of the business model in the future.
- The Department expected to develop a knowledge management infrastructure, which is another key aspect of the business model.[71]

Unfortunately, it was very difficult to determine what, if anything, has changed as a direct consequence of this report.

F. MARKET COMPARISONS

This section examines commercial and government business operations and attempts to determine under what conditions, and to what extent, the two are reasonably comparable. In a general sense both types of businesses are focused on attracting customers, delivering a product or service to those customers, and obtaining revenue from those customers.

[71] Defense Link website, URL = http://www.defenselink.mil/execsec/adr2000/chap14.html, retrieved June 03.

The literature shows the defense business environment – the market – differs from the commercial sector in a number of ways. The fundamental forces which drive the commercial business engines, supply and demand, do not operate in a similar fashion for the military sector. Government and commercial organizations are not governed by the same rules nor are they assessed using the same criteria. At a fundamental level the government does not strive to earn a profit and its legislative action tends to control, in fact reverse, any "growth" in the government budgets. Where growth is a positive corporate metric for the commercial sector (business is growing), it can be viewed as a negative metric for the government sector (taxes are being raised).

1. DoD - Commercial Comparisons

The U.S. commercial sector is the "economic engine" for our country and continues to be healthy and robust. Many organizations – profit and non-profit – strive to emulate its performance as best they can. This sector is roughly summarized as follows:

> The U.S. economic system is built on the concept of free enterprise regulated by competition. The marketplace is the testing ground for products and methods of production and management. A well-managed firm will prosper, and a poorly managed one will fail. Low costs mean higher profits. Investors take risks that, if successful, will be rewarded by higher profits.[72]

A further comparison looks at the differences in the fundamental notion of "competition" between the commercial and defense markets:

> Competition in the defense industry bears little resemblance to the competition of the open market place. In the commercial market, price is usually a major factor in competition. A producer attempts (1) to lower its price on an establish product, or (2) to produce a better product for a competitive price. In both cases, the characteristics of the product are usually known and judged by the customer before a purchase is made.[73]

Certainly, many of the primary attributes of the commercial sector (competition, etc.) are desirable to emulate within the Defense Department. Yet the defense market differs from the commercial market in several important aspects. For one thing the

[72] Fox, J.R., (1988). p. 300

[73] Fox, J.R., (1974). p. 468.

defense market is not determined by supply and demand. Rather than a paying "customer" it is the Congress – through a time-consuming, deliberative, and consensus-based legislative process – which determines the amount the Defense Department will have for research, development and production (i.e., the revenue stream).

Several previous studies have concluded that many of our defense acquisition problems over the years have been the consequence of actions taken due to a mistaken belief that the defense industry fits into a "free market model." Such an erroneous comparison of the defense "market" to an industrial business "marketplace" has been pointed out on several occasions. As one study put it:

> Neither the defense industry nor defense programs are governed by the free market; defense acquisition programs rarely offer incentives resembling those of the commercial marketplace.[74]

Furthermore, the defense business revenue stream does not come from a customer directly but through a congressional system that uses third or fourth party "proxies" who control the revenue on behalf of the paying (taxpayer) customer:

> The size of the defense budget for each fiscal year is determined by domestic political and economic conditions, by international events, and by the interests of the Congressmen and Senators who serve on defense, space and appropriations committees and subcommittees.[75]

As part of his review of the differences between the defense and commercial markets, Fox presented a table of the major differences he has found.[76] One of these differences was that the price of the weapon systems was not normally determined by market conditions. One of the conclusions of his 1974 study was:

> Despite the Defense Department's efforts to simulate a free enterprise environment, the uncertainties of weapons development and production preclude normal competition.[77]

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[74] Fox, J.R., (1988). p. 300.

[75] Fox, J.R., (1974). p. 38.

[76] Ibid. p. 39.

[77] Ibid. p. 469.

In a later book, Fox referenced an even earlier 1962 report on the Defense Industry by Peck and Scherer where they stated more directly:

> A market system does not now exist in the weapons acquisition process. We can state the proposition more strongly. A market system in its entirety can never exist for the acquisition of weapons.[78]

As a counter-point, some researchers have claimed that an analysis of commercial restructuring experiences, when compared to that of the DoD, are similar enough to merit close scrutiny and possible emulation. The areas these researchers focus on seem to be in such areas as product strategies, cooperative programs and downsizing techniques[79]. In an article Peter Drucker suggested a proper understanding of business theory was crucial when attempting to restructure a business.[80] Most of these researchers expressed a preference for drastic cost cutting programs and recommend the DoD hire a team of 'battle-tested industry-restructuring experts' and institute the formation of favorable business alliances.

Even with such changes, however, companies may find that those that do a thorough job of analyzing and identifying the technical and financial risks for a proposed system design will probably find themselves losing to more optimistic competitors. With little business to go around the defense industry community becomes a battleground for corporate survival.

Such a dependence on government work hurts the defense contractors, too. There have been reports where companies have reported that in their attempts to diversify, its engineers were unable to fulfill specifications for commercial products on a competitive basis because of the overhead costs that the engineers and managers had become accustomed to in defense work.

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78 Peck, M.J. and Scherer, F.M., (1962) The Weapons Acquisition Process: An Economic Analysis (Boston: Harvard Business School) p. 57 as quoted in Fox (1974) p. 26.

79 LaBerge, W. B. (1994, Winter). Restructuring DOD: Study the High-Tech Commercial World, Acquisition Review Quarterly, pp. 12-24.

80 Drucker, P. (1993, February 2). A Turnaround Primer, The Wall Street Journal.

2. Congressional Influence

Congress plays an important role in government business operations since it provides the funding for all government operations. In this sense, Congress acts as a proxy for the taxpayer.

R&D programs are considered at two main levels in Congress, that of authorizations and that of appropriations. Authorizing committees develop special expertise in the programs they oversee and review the substance of these programs but the legislation they prepare does not directly result in spending but only provides guidance and sets appropriations ceilings. For discretionary programs the power to write the legislation that provides actual spending authority resides in the Appropriations Committees of the House and Senate.

One example of the negative impact that Congress can have on technology research and development programs was an amendment sponsored by Senator Mike Mansfield (D - Montana) to the fiscal 1970 defense authorization bill. This amendment required that:

> [N]one of the funds authorized to be appropriated by this Act may be used to carry out any research project or study unless such a project or study has a direct or apparent relationship to a specific military function or operation.[81]

This amendment targeted what Sen. Mansfield perceived as a gross waste in general purpose basic research being conducted on taxpayer resources. Although this amendment was only legal for one year, the congressional action sent a strong negative message to government research agencies which had significant after-effects such as the transfer of a number of defense research projects to civilian agencies.[82] This type of legislative action is cited only as an example of the nature and magnitude of interactions that have gone on between Congress and agencies of the Defense Department since WWII[83]. As a consequence of this type of legislative action the relationship between

[81] P.L. 91-121, Section 203, as referenced in Smith and Barfield (1996), p. 24.

[82] Smith, B.L., & Barfield, C.E. (1996). Technology, R&D, and the Economy. Washington, D.C.: The Brookings Institution. p. 24.

[83] And continues to go on today in various degrees across all agencies of the government.

Congress and the DoD can become strained. In the conclusion of a 1973 study of the weapons acquisition process, Dr. J. Ronald Fox made this observation:

> The current relationships between Congress and the Defense Department, among governmental defense agencies, and between government and industry, effectively prevent the system from functioning to its best advantage.[84]

Fifteen years later, in a 1988 updated study of the weapons acquisition process, Dr. Fox's conclusions were that not only had things not changed for the better but, in his estimation, the defense acquisition situation has continued to degrade even further over the years, in spite of intense focus on the part of many in the government and Congress:

> In 1988, the same statement applies, and, in my view as well as that of many in the Defense Department and the defense industry, the situation is worse in 1988 than it was in 1973 or in 1960.[85]

This condition is absolutely central to the problems of technology transition and is indicative of what any S&T community is up against when attempting to transition new technologies and capabilities to a "market sector" that has not demonstrated the ability to function as intended since, essentially, its inception. When coupled with the realization that the S&T community has no fiscal clout over the acquisition resources, the odds are stacked very high against the possibility of success.

3. Market Economic Theory

The "standard" market model is a core element in economic theory. The standard model envisions a world of markets, each of which consists of a large number of unrelated buyers and sellers. All buyers and sellers are assumed to share equally all relevant knowledge of the market and the market characteristics of price, quantity and quality change through the action of informed participants. The quality of goods traded is assumed to be sufficient uniform so that buyers merely seek out the lowest price. On the production side of the model sellers will control their production methods in order to

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[84] Fox, J.R., (1974). p. 449.

[85] Fox, J.R., (1988). p. 300.

keep costs as low as possible in order to sell as large a volume as possible. If all the conditions are met the market is said to be "competitive."

However, the standard market model oversimplifies some important and interrelated economic factors. For example, a purely "competitive" market is not considered to be a desirable, nor sustainable, long-term condition for sellers on a free and open market. Economic research has found that sellers will usually attempt to end this condition as soon as they can:

> Although it is possible to conceive of economic situations in which all contractors survive endless rounds of competition, that is not the typical state of the contract market in either the public or the private sector.[86]

The research shows that sellers will try to reduce the level of competition so that they can command a stronger market position and therefore dictate market prices above their product costs. A couple of the more typical ways a company will attempt to reduce market competition include the acquisition and merger of their competitors.

> Although, collectively, taxpayers stand to gain the most through sustained market competition, they have less individual incentive to politically defend competitive public contracting than sellers have to undermine it. Thus, even though competitive contracting seemingly promises more choice and better prices, the potential benefit for individual taxpayers is often insufficient for them to justify the investment of time and money to enforce sustained competition. Contractors, on the other hand, typically stand to reap a great deal individually by ensuring that the public market structures work to their advantage. Therefore, they are willing to invest the necessary resources to shape public markets in anticompetitive ways.[87]

G. GROUP DYNAMICS

1. Group Behavior and Collective Action

There is substantial information on the formation of groups and the dynamics of their collective behavior. At a very basic level, the primary function of groups and organizations is to advance the common interests of those groups of individuals. As

[86] Sclar (2000), pp 10-11.

[87] Ibid.

social psychologists have pointed out, “the attraction of group membership is not much in sheer belonging, but rather in attempting something by means of the membership.”[88]

Another common trait of group behavior found in the literature was a tendency for small, strongly-cohesive groups to exploit larger more loosely formed groups. In his influential study on group behavior and group dynamics Olson observed:

> Where small groups with common interests are concerned there is a systematic tendency for “exploitation” of the great by the small.[89]

2. Group Behavior in a Competitive Market

The literature search into the theory of groups and organizations identified a number of specific analogies between group interests and behavior and the behavior of a competitive market. There was also a strong correlation found between the theory of groups and organizations and game theory particularly, again, in reference to the actions associated with a competitive “business” environment.

While all members of a group may have a common interest in a general sense they also have antagonistic interests where output is concerned. One of the non-obvious results of a competitive environment identified in the literature is that if the firms in some industry are maximizing profits, the profits for the industry as a whole is less then it might otherwise be.[90] This implies that groups in a competitive market who are looking out for their own individual self-interests will tend to cause the net yield for their group as a whole to be suboptimized.

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[88] Leon Festinger, “Group Attraction and Membership,” in Group Dynamics, ed. Dorwin Cartwright and Alvin Zander (Evanston, ILL: Row, Peterson, 1953) pg. 93, as quoted in Olson (1971), p. 6.

[89] Olson (1971), p. 29.

[90] Olson (1971), pp. 9-10.

With respect to funding of the S&T programs the resistance to provide resources voluntarily as witnessed within DoD,[91] is completely consistent with behavior predicted by numerous contributors to the theory of groups, organizations and games. Despite very strong motives for organizational allegiance (patriotism, ideology, common culture, etc.,) no significant organizational unit in modern history has been able to support itself through voluntary dues or contributions. "Taxes, compulsory payments by definition, are needed."

3. Types of Groups

The study of groups distinguishes a variety of different types of groups. For example, there are "privileged" groups and "intermediate" groups. A privileged group is one in which a subset of the membership have enough incentive for them to bear the full burden of providing the good themselves. An intermediate group is one where no member receives enough benefit such that there is sufficient incentive to provide the good but is small enough that other members will notice if it is not helping to provide the good.

A "federal" group is one which is divided into a number of smaller groups each of which joins to form a federation representing the large group as a whole. If the central or federated organization provides some service to the small constituent organizations, they may be induced to use their social incentives to get the individuals belonging to each small group to contribute toward the achievement of the collective goals of the whole group.92

The distinction between "exclusive" and "inclusive" groups is particularly enlightening and important because market groups differ fundamentally from non market groups regarding their attitudes toward movement in and out of the group. An industry

[91] Each of the military Services resist funding S&T at levels stated by OSD. Overall DoD levels are close to the 3% metric mostly due to the fact that DARPA is a DoD agency and does not report to a military Service – the funds to DARPA do not go through a Service comptroller. The DoN 'corporately' resists funding the S&T account at 3% delineated by DoD; the DoN also resists directly allocating resources for non-Navy unique or joint activity such as ACTDs; and each of the DoN SYSCOM resist allocating resources for S&T functions. Within the larger RDT&E framework (where the resources come from) S&T activity is typically viewed as a lower priority

[92] Olson (1971). p.63.

driven, or "market", group will desire to keep new additions from entering the group and sharing the market since all market competitors are rivals. The ideal end-state condition for a market group would be for the dominant player to attain a complete monopoly of the market. There can be collusion among a few members to actively deter new entrants into the group[93]. Since the fixed benefit drive the membership of a market group to reduce the size of their group, this type of group is referred to as an "exclusive" group.

For nonmarket groups the opposite behavior is found to be true, however. In this case the larger the number of members of a group there is (to share the benefits and costs), the better for the group as a whole. The difference in behavior of the market and non-market groups was found to be due to the cost of the "collective good" which is in fixed supply (resources). In a market condition, if one group gets more of the resources then others will naturally get less of the resources. In nonmarket situations, by comparison, the benefit from a collective good is not fixed in supply. In a non-market situation the supply of benefits is not limited. In this case the non-market benefit will actually expand as the group expands. This type of group is referred to as an "inclusive" group.[94] Whether a group behaves exclusively or inclusively depends on the nature of the objective the group seeks.

4. Group Size

Size was one of the factors in determining whether or not it is possible that the voluntary, rational pursuit of interest will generate group-oriented behavior. Olson's research found small groups were more successful in furthering their common interests than large groups.[95]

With respect to group size, a number of studies of different communities have shown the sizes of the groups that actually do the work are quite small. Olson references studies of groups as diverse as the Banking industry to U S Senate subcommittees, all of

[93] Indications of IPT behavior along these lines can be found in the frustrations expressed at the difficulty in getting new concepts considered by the IPT, particularly Marine Corp IPTs, and the lack of information, and poor communications expressed by almost all survey respondents.

[94] Olson (1971). p. 38.

[95] Ibid. p. 52.

which show similar results: small groups can act more decisively than large groups. Olson also considers the actions or group behavior for corporations. He examines the autonomy of management in the large modern corporation, with thousands of stockholders, and the subordination of management in the corporation owned by a small number of stockholders to illustrate the difficulties of larger groups.

5. Incentives

Economic incentives are not the only incentives. Research shows that people are also motivated by other personal factors such as a desire to win prestige, gain respect, secure friendship, and other "social and psychological" objectives. Indeed, in some cases these incentives with be more powerful than financial incentives. These non-financial, social incentives complicate group dynamics but are a valid component of group behavior. In many cases the non-financial incentives will strengthens group interactions. When group size is small it was found that the social incentives tend to play a more prominent role because "social status and social acceptance are individual, non collective goods."[96] Social incentives are important only in the small group and play a role in larger groups only when the large group is a federation of smaller groups.[97]

6. Coordination Requirements

Another important aspect of group theory is the degree of informal coordination or formal organization that is found to be necessary in order to obtain a collected good. Results of previous research indicate that very small groups do not require formal arrangements because there are sufficient incentives among the members to obtain the desired good. In such cases the members are prepared to pay the entire cost themselves and use informal arrangements to spread the costs more widely. In larger groups, however, it was found that there are not sufficient incentives and the desired good cannot be obtained without some formal group agreement, intense coordination efforts and formal organization. There are a number of reasons for this outlined by the theory, one of

[96] Olson (1971), p. 61.

[97] Ibid. p. 63.

which is the decreased tendency of any particular member to be willing to shoulder a significant cost of obtaining the good. The larger the group gets the more agreement and organization that is needed and the greater the number that will usually have to be included in the group agreement or organization.

7. Costs

One of the problems identified by group theory is that any group that must organize to obtain some 'good' finds that there is a certain minimum organization cost that must be paid irrespective of the amount of benefit it actually obtains and the larger the group size is the greater these minimal costs tend to be. The costs of such organization become an increasing function of the number of individuals in the group. These group organizational costs are sufficiently significant that they cannot be left out of the model.[98]

When the resource costs of a desired good exceed the point where they become more than any single member will bear, the literature mentions research reveals that further costs become necessary. These additional costs are those new costs which must now be incurred in order to obtain needed agreements among group members regarding how the costs will be shared as well as the costs required to coordinate these continued efforts in order to obtain the desired good. These are summarized as additional "costs of communication among group members, the costs of any bargaining among them, and the costs of creating, staffing, and maintaining any formal group organization."[99] As a result of these additional costs the cost of the first unit of any collective good is found to be typically quite high in relation to the cost of follow-on units. Such an initial high cost results in a low initial ROI figure which ends up being a deterrent for further participation by some members and, again, complicates the group dynamics. Furthermore, the theory predicts that even if the potential benefits were known to be immense, the higher absolute

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98 Ibid. p. 47.

99 Ibid.

total costs (of getting any output or product) the "less likely it becomes that even a minimal amount of that good can be obtained without coercion or separate, outside incentives."[100]

8. Integrated Product Teams

In 1995, Secretary of Defense William Perry directed the use of Integrated Product Teams (IPTs) for defense acquisition purposes. The fundamental principles behind IPTs are clearly based on those found in the literature for group theory and those of collective action (small group size, etc.). Although there has been much written about the use and benefits of IPTs within the government there was, surprisingly, very little specific reference to IPTs found in the literature outside of the defense community. Although embraced by the defense acquisition community as an industry "best business practice" the use of IPTs actually had what appears to be an industrial production-line focus where workers were "empowered" by management to shut down production line operations – and save the corporation money – if they saw problems.[101] In spite of its touted success my literature search did not reveal evidence of a continued emphasis on IPTs within the commercial sector beyond the 1980's. Furthermore, within the defense acquisition community – where the IPT concept has become a staple for consensus-based management because of the Perry directive – the effectiveness of IPTs was found to have been mixed. The small number of independent studies found each report significant issues and mixed results regarding IPT performance and effectiveness.

a. Problems Experienced by IPTs

The studies and assessments of IPTs found in the literature all report similar problems with the implementation and effectiveness of the IPT concept. An early study conducted by the Center for Naval Analysis reported an inability to empower government personnel with the responsibilities and authority necessary for effective action. CNA traced this inability to empower personnel to the fact that DoN representatives "cannot commit irrevocably because their resources are not fixed and are

[100] Ibid. pg. 48.

[101] For a good, brief overview of the history of IPTs refer to Kao (2000) and Monk (2002), p. 12.

subject to reductions by the Congress."[102] This same study also found there was a lack of candid communications with the implementation of IPTs. For the DoN, specifically, this study found there were "Chair-of-Command considerations that hamper free and open discussion"[103] and that project managers "are reluctant to be candid in IPT meetings if it means revealing a potential fund surplus."[104] As a result of such an environment some of the objectives of an effective IPT – free and open communication, mutual trust among team members, etc., – appeared to be undermined due to a fear of loss of funding.

Another study, on the utilization of the IPT concept within a major defense contractor, while generally positive about the ability of the IPT structure to "add value" to the government customer, acknowledged a difference of opinion (with such a conclusion) from a minority of IPT participants. This study was also markedly mixed in the reporting of actual results achieved. Even with a corporate implementation of the IPT model this study reported many of the same common teaming and group theory problems; excessive program reviews, workload conflicts by personnel, and very poor communication within and especially across IPTs.[105]

A more recent study of IPT effectiveness in the DoD concluded the DoD continues to have "a long way to go" if it is to meet its own goals of effectively utilizing IPPD methods and IPTs. The primary conclusion of was that DoD's overuse of the term IPT was the key factor that IPTs were not being utilized to their full potential. This study concluded that IPT members were not fully empowered by their organizations, employees were not educated to the extent necessary to execute their specialized tasks, and that the DoD blatantly overuses the term "IPT." This thesis quoted an IPT team leader as saying:

> We use the term 'IPT' pretty loosely within DoD. We call a lot of groups 'IPTs' when in fact they are really working groups or review panels at the action officer level. We give lip service to IPPD, but DoD will never give up the hierarchy under which the decision makers are General Officers,

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102 DiTrapani, A. R. and Geithner, J. D. (1996). Getting the Most Out of Integrated Product Teams, Center for Naval Analysis, CNA CRM 96-49.10, pp. 42.

103 Ibid., pg 4.

104 Ibid., pg 41.

105 Kao (2000).

> SES' and ultimately political appointees. So we convene an 'IPT' made up of action officers, all of whom recite a chorus of 'I need to take this back to my principal' and that principal forwards it on to his boss who (hopefully) makes the decision(s).[106]

There are also hints of internal DoD decision-making conflicts evident in the conclusions. As Monk reported:

> The IPPD process is considered to be a mindset that runs counter to the ways things have been done in the past. It also runs counter to the military culture where hierarchical processes have and continue, often necessarily, to be stressed.[107]

One of the recommendations made called for the development of metrics to measure the success of IPTs in DoD because the study revealed that none were found to exist. The observation was also made that the DoD acquisition workforce must be shown clear evidence that these practices will truly improve the quality of their work and would not end up being just another "fad."[108]

9. Consortiums

The most interesting organizational structure found in the literature for effective business operations, technology development and transition was that of a consortium. R&D consortia are self-governing organizations (usually nonprofit) which are run for the benefit of their members.[109] The owners are the customers, and their purpose is to develop new technology and put it into practice. Primary funding for the consortia came from the members companies, with additional support coming from the government when the technologies involved prove to be of significant or strategic interest.

In general, these R&D consortia are seen as consensus-driven organizations which have a relatively short time horizons and low risk tolerance. Their focus was on developmental efforts rather than research and they were judged as excellent vehicles for taking research through the development stage and putting it into practice. Because of

106 Monk (2002), pg 59.

107 Ibid., pg. 61.

108 Ibid., pg. 63.

109 Corey (1997), pp. 11.

the consensus-driven component of the planning process the projects selected for development by consortia tended to favor low-risk, near-team projects greatly.[110] Industry members tended to use the consortia framework to gain benefits of standardization but avoided entering collaborations where the product developed might give their competition a competitive advantage.

The research on consortia pointed out the essential role a "core group" played in the formation and governance of a consortium. It suggests that a consortium's effectiveness depends heavily on the quality of its "core group" leadership. Personal leadership was a critical factor in a group's success but the research results highlight the essential importance of consortia "core group" leadership.

A consortia's effectiveness was linked to a clear and unambiguous mission that had a high net value to each member. Of those studied the most effective groups were those with a strong and effective core group. The ineffective groups were found to have suffered from divergent interests, competitive rivalry and mission ambivalence.

The most effective consortia pursued extensive coordination activities, including interactive communication schemes between consortium members and customers. These consortia also utilized liaison representatives, maintained close proximity to their customers, conducted technology demonstrations at customer facilities and documented results religiously. This level of professionalism and operational tempo mandated the consortia attract and retain highly competent technical and administrative personnel.[111]

The group behavior of consortia members was not without problems, however. Corey notes there was reluctance on the part of some consortia to be proactive in many of the activities required to transfer the technology developments. In the cases he studied the reluctance appeared to be caused by an aversion to the idea of needing to "sell" their technology developments. These types of "marketing" activities seemed foreign to those normally engaged in conducting the research and development efforts. Also, some consortia were found to be initially unwilling to fund necessary investments for

[110] Corey (1997), pp. 152.

[111] Ibid. pp. 144.

technology transition functions. In these cases the consortia involved preferred to concentrate their funding on the research side of technology development. Corey observed the transfer, or "diffusion", of technology was inherently a difficult process. He equated it to the marketing of change, often in the face of strong resistance.

a. Differences with Private Enterprise

One of the most interesting aspects of the consortia study was the insight provided regarding the challenges of managing the consortia institutions. As Dr. Corey commented:

> … what I have learned is that the problems and requirements of effective consortium management differ significantly in degree from those of private enterprise, for three reasons. First, each consortium has a plethora of internal and external stakeholders to satisfy. Second, most are deeply involved with government agencies, ranging from state and federal regulatory agencies and administrative departments to the United States Congress. Third, unlike private enterprise, the owners of consortia are the clients.[112]

10. Military-Civilian Relations

Within DoD the issue of military-civilian relations is a sensitive issue, from both community perspectives, yet these relations are central to many of the issues that hinder such efforts as research and development, technology transitions, and operational effectiveness. The problem is ultimately a power struggle over which community should have the authority to control military readiness and operations. History, however, is clear on the subject:

> Civilian control of the military has been an absolute and unquestioned principle throughout U.S. history. The June 12, 1776, Declaration of Rights of Virginia sets forth this principle: in all cases the military should be under the strict subordination to and governed by civil power." The Constitution incorporated this principle, giving both the President and the congress power and responsibilities to ensure civilian control, it remains ill defined in the later 1980's, as it has been for decades.[113]

[112] Corey (1997), p. ix.

[113] Fox (1988), pp. 107.

The struggle over authority, responsibility and appropriate civilian influence over the military came to boil, and a successful (temporary) resolution, during WWII. The urgent high priority demands of wartime operations combined with the appointment of a strong-willed scientist to a defense advisory position of authority and responsibility allowed great progress to be made. The Office of Scientific Research and Development (OSRD) was widely acclaimed as being extremely successful in responding to wartime scientific demands. This office was directed by Dr. Vannevar Bush, who felt the country needed a special organization to harness its technical talent. OSRD teams shaped most of what the government's research activities through World War II and fleshed out Bush's vision of what scientific research and development could do when put to military use. These wartime successes would be the seed for later efforts to recreate these successes by requiring agencies to operate more like the businesses that delivered the weapons systems in high quantity and at high rates during WWII.

Vannevar Bush was a talented, intelligent, strong-willed scientist who accomplished great things while running OSRD. He felt strongly in the need for pure research and that a strong scientific community was vital to our national security. He was instrumental in the establishment of the National Science Foundation (NSF) and, to a lesser extent, the Office of Naval Research (ONR). He was, however, very forceful and opinionated and was considered by many to be "elitist." His forceful management style clashed with an equally forceful, certainly more politically savvy, military contingent coupled with a much weaker civilian leadership structure which, ultimately lead to the diminishing of his access to senior administration personnel (like the President, for example) and, eventually, a limit to his responsibilities.[114]

Part of the cause of the frequent "clashes" that would arise under his tenure was due to the fact that Vannevar Bush was fundamentally uncomfortable with the Defense Department having a strong research agency, for several reasons. For example, he felt the Services would attempt to direct the research and hinder scientific inquiry and progress. He was also sensitive to limited resources and was convinced that DoD revenue would necessarily limit the amount available to the rest of the scientific

[114] Zachary, G. P. (1997). Endless Frontier, New York: The Free Press, Chapter 14.

community. He was also concerned that interservice rivalry would cause a great amount of waste in the DoD research conducted.

The Navy's military-civilian relations were so severe that Vannevar Bush is reported to have later said he gave the atomic bomb project to the Army rather than the Navy because of their problems in dealing with their military/civilian-scientist relations.[115]

The literature reveals a number of contributing factors regarding the difficulties in the DoD military-civilian management infrastructure. The overall DoD method of implementing civilian control U.S. military activity is greatly weakened by the brief tenure of the civilian appointees and their military counterparts. The average assignment is less than three years. For the civilians, the President makes the appointments and they need to be approved by the Senate, which becomes a political nightmare all of its own. To make matters worse, most political appointees have "no relevant experience but have been loyal to the President's political party."[116] This opinion was reinforced in an interview conducted for this thesis with a former DoD political appointee. This former DoD official pointed out that almost all defense acquisition political appointees have no acquisition experience when they take their appointment.[117] Most of these [political] appointees had no significant experience in the Pentagon and had no idea what it took to get things done. His sentiment was, "They initiate a lot and accomplish little." In some cases he felt they might leave doing no harm but, more often than we would care to know, they leave the system in worse shape than when they arrived. A consequence of the political appointment system is that these appointees come with a short-term focus which (as with Congress) causes them to search out a "quick-fix" approach to problems rather than to the structural reforms needed for lasting improvements. As Fox (1988) stated the situation:

> The Pentagon system for distributing responsibility and authority between civilian appointees and military officers seriously impedes the efficient

115 Westrum (1999), p. 18.

116 Fox (1988). p. 107.

117 A exact transcript of this interview was not be made due to a recorder malfunction.

> and effective functioning of the weapons acquisition process. If sufficient defense capability is to be maintained efficiently and effectively, civilian control of defense activities must become a working reality. Civilian appointees control few of the incentives or penalties for personnel performance. They have only as much authority in the Defense Department as do the board of directors in a private corporation, often less. Qualified civilians must, in deed as well as intent, control information channels and make the final decisions on defense priorities. Finally, to achieve stability within the department, it is imperative that Secretaries and Assistant Secretaries serve at a minimum, four-year terms of office. Fundamental reform must begin both in Congress and in the Pentagon.[118]

With respect to the overall architecture of the DoD and the Services there is also a very complicated organizational structure due to the reporting requirements of a dual military-civilian leadership chain of commands. This unique reporting arrangement causes problems at all levels:

> A factor that continually thwarts efforts to reform management procedures is the ambiguity of the relationship between Secretaries and Assistant Secretaries and the military officers and civil service personnel who serve under them. Military Officers' promotions are controlled by their military service promotion boards. Tenure regulations protect civil service from dismissal in all but the most flagrant and extreme cases of irresponsibility.[119]

a. The China Lake Model

One of the most innovative and successful military-civilian organizational experiments conducted was that at the Naval Ordnance Test Station (NOTS) at China Lake, California, in the late 1940s. Close military-civilian cooperation was a cornerstone to operations at China Lake from the very beginning. There were many factors which contributed to the organizational effectiveness but one of the major components critical to the technical success of the development activity was the innovative military-civilian architecture which was modeled on earlier OSRD principles put in place by Vannevar

[118] Fox (1988). p. 146.

[119] Fox (1974). p. 459.

Bush. Through experimental ordnance facilities at two locations,[120] Navy's Bureau of Ordnance decided to:

> …operate these installations on the principle that the technical activities would be conducted and directed by professional civilian scientific and engineering personnel, and that the role of the military personnel would be that of providing the necessary knowledge of operating conditions plus the administration required to make the laboratory a part of the Naval establishment in the broadest sense. With this in mind those laboratories have consistently been staffed with professional civil service personnel of the highest quality obtainable, under the leadership of a Technical Director in whose hands the responsibility for the technical achievements of the laboratory is placed. [121]

The struggle over operational principles is difficult but remains at the core of the issues. China Lake's principles of operation, formulated in 1946, were drafted to:

> … make clear that civilian scientists worked in partnership with the military, not in subordination to it. The principles also made clear that top leadership was shared between a commander and a technical director, rather than having one report to the other.[122]

The intent behind these principles was to create an environment that would attract and retain the very best in scientific and engineering talent. This intent has not been embraced without organizational struggle, however. A summary of the civilian-military struggle, and the erosion of authority which has resulted, is informative:

- Civilian-Military operating 'principles' were established (1946).
- These principles were reformulated with minor changes (1955).
- Major changes were made, placing the military in charge of the civilians (1974).
- The principles were eliminated altogether (1976).
- The principles were rewritten but not reissued (1980).
- The principles were reissued as "operating principles" (1985).

[120] Two facilities were used, one on the west coast at China Lake, and the other on the east coast, at White Oak. Both of these organizations have been very highly regarded.

[121] BuOrd Order No. 28-51, (1951, June 22), p. 1, as quoted in Westrum (1999), p. 14.

[122] Westrum (1999), p. 258.

These changes in the principles reflected a tug-of-war between the 'civilian-military partnership' charter and the more traditional role as a Navy laboratory carrying out the Navy's wishes.

Many of the problems encountered as China Lake implemented their 'experiment' are completely analogous to those we face today. As an example, in the late 1980's one captain described the organization changes which were happening:

> In the 1960's … there was still a good strong cadre of qualified people in the Navy … Bureau of Ships, Bureau of Weapons, Bureau of Aeronautics. In the 1980's I don't think it exists to that extent … the poor guys in the bureaus, their time is spent on budgetary problems.[123]

Some of the things mentioned here–spending an inordinate amount of time on budgetary problems and a lack of strong qualified people–are equally valid complaints today. One of the most important aspects of the management arrangement at China Lake was that uniformed personnel were very supportive of the mission and this support was instrumental to the operational success of the laboratory. As was pointed out:

> They represented the customer. They brought fleet experience to weapons evaluation and acted as advocates for the systems after development.[124]

The usefulness of these R&D facilities was also crucial to success. The close proximity of laboratory and test range was very beneficial to the high operational tempo and allowed many iterations of a design to be tested very rapidly:

> Novel ideas could be developed and tested with little paperwork or delay. The key was to employ the full spectrum of R&D activities from initial conception to pilot production.[125]

China Lake developed its goals from a deep understanding of the needs of the fleet, aided by the pilots who served on the station's staff.[126] Many of the very same transition difficulties (internal Naval rivalries, industry, etc) are very similar to those still

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123 Ibid. p. 260.

124 Ibid. pp. 20-21.

125 Ibid, p. 22.

126 Ibid. p. 357.

in effect today. What most concerned Dr. William McLean was that the system must respond to the needs at the user:

> If our designer is to be truly successful, he must have a more direct contact with this consumer than can every be provided by a set of written specifications … It is essential for the designer to question his specifications and to go back to primary sources in order to develop a real understanding of his problem, and the basis for the need, if he is to create a successful product.[127]

As a consequence of the steady erosion of its authority and management flexibility at China Lake over the years[128] the role of government laboratories became more of a watchdog organization for Washington rather than a research and development laboratory. This diminished role reduces the effectiveness greatly.

Some of the 'transformational' changes being implemented today also appear to be in-line with suggestions made in previous studies. For example, among the numerous changed suggested by Dr. Fox was for a new, more flexible, more rewarding personnel system along the lines of the one demonstrated as successful at China Lake:

> Congress should establish an alternative personnel management system for key acquisition personnel that would provide greater flexibility in status, pay and qualifications of civilian employees, particularly at the senior level. The successful China Lake project, in which key civilians received pay incentives and promotions, based on performance, is worth emulating.[129]

Although the new personnel system being implemented within DoD may help the situation it appears to be off the mark and skirts a more fundamental issue which impedes change – that of military-civilian relations within DoD. What made China Lake successful was not simply a flexible personnel system, which certainly helped, but the presence of a strong, positive military-civilian environment of collaboration that allowed a high caliber workforce to flourish. The personnel system being implemented in our current transformational changes may prove beneficial but the biggest impediments to significant changes will not be surmounted without a candid discussion of the military-

[127] Ibid. p. 92.

[128] Erosion was more severe at White Oak, which was closed down through the BRAC process.

[129] Fox (1988). p. 314.

civilian leadership issues. In order to introduce "transformational" changes into the Navy the DoD needs to embrace further fundamental changes and real change is based on our Constitution and, as a result, will need to be directed from the Congress:

> When Congress reactivates the concept of civilian control of the military, meaningful and lasting reform can begin. There is no other starting point.[130]

H. TRANSITION EXPERIENCES

This section provides insights regarding technology transition experiences across the industrial and military sectors.

1. A Small Manufacturer Perspective

The information presented here is taken from notes from an interview with the President of a small manufacturing company. This company has been in operation for forty years and is publicly traded on the NASDAQ stock exchange. In 2003, this company reported net sales in excess of $750M and net earnings of approximately $20M. This company manufactures components for military and commercial customers throughout the world. They employ approximately 400 people and use a large (>100,000 sq. ft.), highly automated, manufacturing facility. They manufacture more than 1 million items annually, shipping more than 2,000 products to more than 1,500 customers throughout the world

The person interviewed was not familiar with the DoN Future Naval Capability technology transition process and so the information collected is more appropriate as a part of the literature search on the general issue of technology transition. The experiences from an industry representative provide a useful benchmark for comparing DoN FNC technology transition experiences with those from the industrial sector.

a. Corporate Tech Development

The role of "science and technology" in small companies appeared to be slightly different for small companies, as compared to the larger DoN resources, but there

[130] Fox (1974). p. 458.

were many similarities in the whole product development process. When asked to talk about the science and technology, product development, and technology transition experiences of his company, the industry representative was informative:

> We do not do basic science. We don't even do basic engineering really. Instead, as a small manufacturing company, we take the results of other people's science and engineering and modify it in some way to turn it into a product that fulfills someone's needs. If we didn't do this often and well, we'd soon go out of business. The search for useful existing basic science or technology is usually a hit or miss proposition, dependent primarily on the individual efforts of the people involved in the transition process.

In response to a question asking how his company approaches the problem of meeting customer needs the response was:

> I get new products to the market in two ways. First, meet the needs of new markets using current products, possibly with minor changes. Second, identify and develop new concepts to provide new products to current markets.

When asked if such an approach appears to help his company facilitate "technology transitions" the discussion was a bit more vague:

> In every endeavor which results in transitioning a concept into a useful product, it must be understood that there is no single transition step. Instead, there are an almost unlimited number of transitions. Every time one person learns of a concept and then uses it, in any form, in his own work, a transition has occurred.

With respect to the usefulness of committees, teaming arrangements or group decision-making bodies this person relates the following experience from industry:

> Because there are very few people actually actively involved in the product development process, it becomes a very personal process. Attempting to coordinate it by committee is seldom effective. Even if a committee exists, the real decisions are usually made outside the committee as a result of personal selling of ideas or dictatorially.

Additional comments made have direct analogy to some of the more fundamental difficulties of technology transition, regardless of the development environment being of the industrial or government sectors:

> I believe that any program based solely on the developers recognizing the best applications for their inventions or the applicators recognizing the best available technology that might be brought forward, without some mediation agency who is comfortable in both worlds, is doomed to failure.

Some of the issues predicted in the literature search do indeed show up in the experiences encountered by industry. For example, relative to group size and formal coordination requirements, the President of manufacturing company commented:

> In small companies lines of communications are so short, and pertinent groups so small, that (formal programs) are not necessary. Formal programs, and the meetings they generate, in general, do little to engender trust and teamwork, the cornerstone of effective product development. Even if a formal program exists, the real decisions are usually made outside the confines of the program.

In response to a question asking what might be missing in our technology transition efforts, this interviewer suggested:

> I believe that almost all product development or transition programs ignore one crucial element. That missing element is the bridge between the "inventor" and the "user". There are millions of great inventions available, and there are at least as many unfulfilled needs, but the challenge is to get them together, which is something I call innovation. Despite everything that has been written about managing innovation, innovation is a lot of art and a little science.

b. Innovation Skills

The President of the small manufacturing company identified four key skills which, he felt, helped to differentiate between excellence and mediocrity among those responsible for product innovation. The skills mentioned were:

- **Unspecializaton.** This was described as a conscious effort to break out of isolation and gain a broader look at the world. It was commented that this could take on many forms within the industrial sector. One example cited, "If an engineer never visits a customer, especially an angry customer, he becomes isolated from that world and only sees it filtered through one or more third parties."
- **Mediation**. This was described as "speaking the language and needs of other groups." This industry representative commented that in order to make use of the "unspecialization" skill an employee would need to learn how to recognize areas of compatibility and areas of conflict among the groups involved in the product development and technology transition process. Such recognition was mentioned

as being the first step in the mediation process because it allows a person to emphasize compatibilities while providing a method of working around the areas of conflict. As was commented, “The conflict has to be resolved first or the compatibility will never be recognized. Such a skill requires working out comprises that enable both groups to feel they are vital parts of a partnership.”

- **Openness**. Being “open” to all ideas. The importance here was the need to be viewed within the organization as being open to ideas, and fair, in order to be presented innovative ideas in the first place. From this person’s experience, what a company doesn’t want is a situation where an idea gets suppressed and the critical “grain of truth” that was behind the idea becomes lost to a competitor. One of the comments made was that it is the “stupid ideas that are most often the cause of breakdowns between groups, and you can serve as a buffer and filter between the groups to avoid such breakdowns.”

- **Approachability**. This skill seems somewhat similar to “openness” but the distinction made was the importance, need and benefit for networking and being approachable (regarding new ideas) throughout the organization. One of the comments made was “You will not learn or gain approachability by sitting at your desk. You have to actively mix with the groups you need to have approach you with ideas, and you will have to gain their respect and confidence. This may be a personal style issue, but I have seen more people’s effectiveness drastically decrease because they could not establish the required links with other groups.”

c. Business Environment

With respect to describing the proper “business environment” for innovation this person offered the following observations:

> There must be an atmosphere where everyone is encouraged to openly communicate with everyone else involved. One of the most important aspects of the atmosphere has to be an acceptance of failure. Unless everyone is as comfortable with communicating failure as with communicating success, the organization will lose the bulk of its experience. There is an old engineering saying that you learn more from your mistakes than you do your successes, and I firmly believe it to be true. Therefore, if news of failures is suppressed, the growth of the company will be severely compromised. Just because an idea failed to pan out for one purpose, it might be just the silver bullet needed for another purpose. I have seen this happen many times in my career, and expect to see it even more.
>
> A corollary to this acceptance of failure is a need for what I call "breathing space", particularly at the earliest stages of development. In the context of a small company, this usually means "Don't tell Marketing." What this really means is don't talk too much about new concepts being developed until there is a pretty good chance of success. Otherwise, expectations can

> get so high that it is impossible to get off of a losing technology gracefully. When that happens, failure becomes unacceptable, and people will look hard for a scapegoat. The next time, that person will be far less eager to come forward with a new idea. Admittedly this seems to be at odds with the previously stated goal of open communication of efforts, failures as well as successes, but it is really not. Just because the idea did not pan out doesn't mean that it is buried. Since it was "just an idea" rather than the "savior of the company", it is easy to talk about what was learned during the effort, thereby enhancing communication.

This person emphasized that the comments made should not be interpreted as meaning that corporations do not apply pressure for results in the development process, only that the most successful companies will be able to adjust the pressure applied appropriately for the stage of development of the concept. This person went on further to say:

> There is no known reliable method for finding the right balance in any given situation, but I can almost guarantee that a committee is the least able to strike the proper balance. Perhaps as programs get bigger and organizations more complex, a committee might be workable but in smaller organizations, that is why they have managers.

d. Barriers to Effective Product Development

A number of barriers to the product development process were mentioned:

- **Money**. “The lack of funds is always a barrier to transitioning technology.”
- **Secrecy**. This person commented that “small companies get most of their new technology from outside the company.” While small companies might be willing to “buy into” a development program for the technology innovations they might get from the arrangement, this person – based on his experience – felt that companies will seldom license a technology when royalties are involved nor will they pay an outright sum of money for risky technology. “The small companies of my experience have only their technology to help them survive, and when there are continuing strings on that technology to outside the company, there is a level of discomfort. When an outside entity knows that they are using a particular technology, and also probably how they are using that technology, it is almost impossible to keep that knowledge away from competitor. Maintaining secrecy is particularly difficult when the outside agency is part of the Government, but customers are almost as bad and a frequent source of leaks is a vendor who also serves competitors.”
- **Language**. This was described as a manufacturing vs. engineering issue. It was commented that “open communication, and cross assignment of personnel,

can ease this problem. However, to make sure it does not cripple the efforts, a mediator is necessary to monitor progress."

- **Point of View**. A difference in points of view is a subset of the Thomas S. Kuhn paradigm scenario.[131] It was suggested that open communication and cross assignment can ease this problem as well.

- **Ignorance**. If you never learn of a concept, you will never be able to make use of it. This barrier may seem obvious but industry experience is that it is often overlooked, particularly as budgets get tight.

- **Not Invented Here (NIH).** From this person's perspective this barrier is probably the most difficult one to overcome, and applies to ideas from outside the organization as well as to ideas trying to cross between groups within an organization. It was commented that, "Unless there is an atmosphere of trust and mutual respect, NIH will kill almost every new idea. It is here that managers demonstrate whether they are leaders or not." While competition between groups can be beneficial, it can very easily get out of control and change to a very negative force.

e. A Summary of One Company's Product Development Process

In describing their product development process this person commented that, at some point in the product development cycle there is a need to impose controls over the process. At the same time, there must be room left for "seedlings to sprout on their own" as well as the means to nurture these concepts to maturity. The comments made were:

> My current company has a two stage "system" for this that is not unlike the systems I have seen in similar companies. The slack is primarily built into the Engineering organization. The Engineering test lab has the capability to manufacture almost anything that the main shop can produce, and the wherewithal to build the capability to do things that the main shop can't. This gives me the opportunity to try new products, or permutations of existing products, outside the mainstream of the company, which is dedicated to shipping products to customers. While these resources, and the accompanying budget, is controlled by the Chief Engineer, it is purposely set up with more leaks than a colander, to allow people in the organization outside of Engineering to have the opportunity to experiment with a pet idea. The money spent on these efforts is a tiny percentage of the overall company budget, but is very important both for actually developing new ideas and for fostering the atmosphere for even more new ideas.

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131 As described at length in Kuhn (1996). The Structure of Scientific Revolutions. (3rd ed). Chicago: University of Chicago Press.

> While this process seems a bit chaotic, it really isn't. The reason it is not chaotic is that it is based on close personal observation and limitation by the upper management of the company. It is important to remember that there are only two layers between the President of the company and the machinist in the Engineering model shop, so keeping a close eye on what is happening is a relatively simple task.

f. Some Personal Philosophy

What follows are some miscellaneous comments provided during the interview that provide general insight into the technology development and transfer process as experienced by this person, from an industry perspective.

> Despite all of the writings about "managing innovation", the breakthroughs do not come from managed, tightly structured programs. The development of those breakthroughs into truly useful products takes more structure and discipline, appropriate to the scale of the required investment, but the seeds need air and light in order to get started. And you need a lot of them.

An early stage of the product development process, the experimentation phase, was described as similar to the traditional "brainstorming" process where the quantity of ideas is more important than the quality of any individual idea:

> Anything that reduces the number of ideas being generated reduces the chances that a useful idea will be found. For this reason, I have always tried to manage the development process similar to a brainstorming session.

The person had concerns over the dangers in discouraging new ideas before they have the opportunity to be tested. It is important, this person contended, to establish an atmosphere where people have a certain amount of freedom to act autonomously, keeping the checks and balances in place but quite loose and mostly out of sight.

> In a small organization, MBWA[132] is almost enough to allow a manager to collect sufficient information to insure that no program can go too far before it gets some scrutiny, but provides enough flexibility that new ideas can be tried out informally before they get anything but peer scrutiny. Peer scrutiny occurs automatically, because in order to get anything done, the person who wants it done has to have some help. It might be some

[132] MBWA = "Management by Walking Around"

machining, it might be a quick test, it could be just help modifying a computer program. In some manner, peers have an input into almost every new idea that gets tried. Obviously, at this informal stage of peer review, only peers known in advance to be most likely to agree with the worth of the new idea will have an input. This is because the person with the idea is most likely to ask help from those he considers most likely to help him. Because at this stage, resources are not formally designated to a project and therefore must be diverted from other sources, the helper is giving up something. Human nature being what it is, he is likely to give up something to help someone else's idea only if he supports the idea, or owes a quid pro quo.

A balance has to be struck between allowing flexibility and forcing development underground. Development will still occur, even if forced underground. Most engineers, and many marketers, want to be innovative. If you put them in an atmosphere where they are encouraged to try things, without too much red tape, you are likely to yield some outstanding results. If you stifle that opportunity, either inadvertently or purposefully, you are likely to get some results that you are very unhappy with.

If you are successful in developing a process for developing new technology, how do you go about keeping it focused on those things that need to be developed?

This statement begs the question that we know what needs to be developed. As is hopefully clear, on one level we don't want to keep it very focused. At that level sufficient focus is usually provided by the choice of the people working in the area. If you are interested in developing capabilities and products in the area of composites, you don't hire an electronics engineer. While a decision like that is self evident, there are other choices you can make that, while more subtle, can have very pronounced effects on what type of projects are worked on. Choosing a composites engineer who started as a mechanical engineer will yield different results than choosing one who started as a chemist. Similar, one from an aerospace background will differ from one from a sporting equipment background. Making choices like this is not focusing the efforts, merely getting them pointed in a general direction. This allows for a lot of ideas to be floated while ensuring that the majority will be in a field of potential interest.

At the next level, making use of some of these new ideas takes a greater focus than is afforded merely by the selection of people. The choices now are to focus the efforts or focus the people. In small organizations, it takes too much overhead to focus the efforts exclusively. Instead, you have to put your investment in people, not systems. Engineers, in my experience.,

are largely self motivated people, at least those who choose to work in small companies. If you try to over control them, they will let you, but their heart won't be in it, and most will probably leave in a relatively short time, totally frustrated. This is another reason to focus people, not control their every effort. Small companies who are successful in meeting their customers needs focus their people on their customers. Does this sound like something you heard in a TQM class? It was true long before anyone coined the term TQM, and will be true long after TQM is discredited and discarded for all the wrong reasons. For engineers involved in developing products that they want their customers to buy and use, a focus on, and understanding of, the customer's real product needs is central to the success of a product development program. Once the engineer has a good understanding of what the range of needs are, he will naturally focus his efforts toward meeting those needs. Thus, the only external effort to focus the efforts is to insure that the engineer is working for the right customer.

In my experience, Salesmen almost never understand what a customer's needs are, and Marketers are only slightly better. This is not to say that engineers are all that good either, but you have to realize that even the customer usually doesn't know what he needs. Customers generally have some idea what kind of problems they have, but they don't know how to best solve them. The difficulty arises because it is difficult to ascertain just what the root causes of the problems are. It is important to remember that the customer of an engineered product is also transitioning technology. For commercial success, you want your customer to transition your technology into his product development rather than that of a competitor's. Your best opportunity to make this happen is to provide a product that most closely meets your customer's needs. Remember, one man's science is another's finished product.

2. Consortium Experiences

R&D consortia were established in response to perceived external threats to U.S. technical competence and competitiveness. Significant congressional legislation provided incentives for the formation of these joint technology development and transition vehicles. As a result, by 1993 there were 592 consortia registered under the National Cooperative Research & Production Act.[133] These external threats created an atmosphere of urgency and allowed collaboration on a level that might not other wise

[133] Corey (1997). pp. 110.

have been feasible at the time because of competition and a free market economy paradigm. A summary of the specific congressional legislation enacted:[134]

- National Cooperative Research Act of 1984
- Omnibus Trade Bill of 1988[135]
- Defense Conversion Reinvestment and Transition Assistance Act of 1992[136]

The factors which contributed to the rise of R&D consortia in the U.S. include:

- There was a perceived national crisis
- There was a favorable legislative climate
- The industry was experiencing escalating research costs
- There were changing perceptions of competitive advantage
- There were changing industry sourcing patterns

The literature reports R&D consortia have demonstrated themselves to be highly effective vehicles for R&D cost-sharing in areas of common interest to the member companies.

> …consortia have contributed significantly to the development and diffusion of technology in the industries they serve. They have been effective in building industrial and academic infrastructures. Many have developed new products to meet member-company needs and grow the end markets they serve. Some have played an active role in the commercialization of new end products. They provide vehicles for cont- and risk-sharing in research and development that are of broad use to the industries they represent, and ultimately to the nation. Consortia serve as forums for the development of strategies for economic growth and national competitiveness, without limiting interfirm competitiveness or imposing a national industrial policy on US industry.[137]

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[134] Ibid. p. 113.

[135] This Act created the NIST ATP program.

[136] This program was administered by ARPA (now DARPA).

[137] Corey (1997). p. 147.

a. Conditions for the Consortia

In his study of consortia, Prof. Corey identifies a number of conditions which he found led to the rise and success of the consortia he studied. These conditions were:

- rapid technology development
- escalating research costs
- growing use of external R&D sources by corporations
- industry-level R&D agendas that are beyond the resources or the self-interest of individual firms
- growing use of cost-sharing arrangements between industry and government, for the development of the national economy, the support of the defense establishment, the protection of national resources, and the protection of the environment
- industry and government funding
- a favorable legislative environment

b. Personnel

The six consortia Corey studied saw great benefit in assigning technical personnel to their consortium for "technology diffusion" purposes. Corey's study found those consortia that used direct hired staff experienced greater difficulty with the technology transfer process. According to researchers interviewed, the technology "just seemed to lay there." In general, success seemed to depend heavily on the emergence of member-company product champions.

Getting the right people in the right job was also an important part of the technology transfer equation for the consortia. As a leader at IBM stated:

> I try very hard to get a match between the people who have the right job assignment and can make use of the information once it's known. If they don't have the right job assignment then they are still pushing it inside the corporation instead of pulling it in.

At those consortia where the staff was direct hires, tech diffusion was found to have been more difficult. According to researchers the technology "just seemed to lay there". Success seemed to depend on the emergence of member-company product champions.

c. New Ideas/User Needs

For consortiums the technology transfer process was vibrant and very involved. New project ideas were generated from task forces and committees. For some consortia program managers worked with contractors to carry out the work. Some used "Technology Transfer Managers" (TTMs) to play an important role in putting the newly developed technology programs into use in member organizations. To facilitate better communications liaison executives were located in regional field offices to act as a bridge between the TTMs and those local managers in the utilities. In order to identify the specific people for whom a technology fills a need, some consortia used "Technology Interest Profile" which was used to help identify target customers for a wide range of technology applications.

The timely reporting of results was a major emphasis area for successful consortia. Numerous test, summary and progress reports were circulated or made available to the member companies and partner organizations. In most cases reports of various level of detail were prepared and made available for others, depending on their needs. In order to "get the word out" one-page bulletins were disseminated to those who might have an interest in specific technologies and complete reports are sent out on request.

d. Outreach Activities

Some of the consortia conducted over 200 workshops each year to communicate new technical developments in direct, interactive sessions. To make their technical knowledge as readily available as possible some developed an automated e-mail distribution system where requests could be sent and computer servers would automatically distribute hundreds of technical documents to the requestors.

Consortia partners also made frequent contract with "commercializing partners" to familiarize potential customers and market members with the newly developed project developments. The task of "marketing" fell to the consortium which, in turn, relied on its membership for active participation on task forces and advisory committees and in order to provide market research for their membership needs. Consortia members essentially fielded a technical liaison "sales force" in the regional

offices to identify and communicate with important decision makers. Through the liaison function and the demonstration approach the consortium has developed a “push” marketing strategy. In going directly to the customer field sites they are using “pull” techniques.

e. Technology Demonstrations

Technology Demonstrations were found to be very important to the success of the R&D consortia. In the technology adoption phase host members increasingly request the evaluation of a technology achievement through some sort of operational demonstration. Successful demonstrations are widely publicized through technical papers and bulletins which are given wide circulation to communicate results.

It was found that end-product demonstrations required great skill in forming vertical alliances among consortium member companies and outside commercialization partners. These agreements were not always easily reached, however, as they typically required intense negotiation and adequate profit opportunities (“return on investment” from participating member companies) before agreements could be reached.

Additionally, the high cost of technology development activities mandated that R&D consortia develop much improved “R&D delivery systems.” This was accomplished over the years through an increased use of more integrated and focused technology demonstrations. The success of these demonstrations have had an impact as well. In his book Corey reports that consortium performance is now being judged on the extent to which the consortium has been able to demonstrate the technology development in an operational scenario. Most significantly, consortium management and corporate governing boards are slowly coming to realize that building and maintaining effective channels for the demonstration and delivery of technology takes substantial funding. This realization, Corey observes, is a fundamental shift in thinking from the previous traditional concepts that the role of the consortium is to do research and development and the role of partnership members is to take it away.[138]

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[138] Corey (1997). Chapter 5.

f. Technology Transfer

Specific examples suggested that technology transition was most effective when it was:

- Carried out by highly motivated individuals on the receiving end
- Internally supported by top management
- Executed in close proximity with scientists
- Performed in a rewards-based environment.

To be most effective, interactive communication between consortium members and customers was found to require very close proximity. The technology transfer process was facilitated by utilizing well-established and well-maintained channels and risk was minimized by setting up demonstrations of new technology.

The technology transfer process was not always easy for consortium members. In many cases there was a reluctance on the part of the consortium members to be proactive in the "diffusion of technology." This reluctance was found to be linked to a negative perception regarding "marketing" the technology developed: the idea of having to sell technology seemed beyond the scope of those engaged in the scientific discovery process. This mindset was detrimental to the entire technology transfer process and became a significant obstacle. Corey reports that some consortia were initially unwilling to support an organizational investment in "diffusion functions," preferring to concentrate their funding on basic research and the creation of new long-term technology advances. The "diffusion of technology" was found to be inherently difficult; at a fundamental level it was found to be the "marketing of change," and was often required to be accomplished in the face of countervailing resistance.

Consortium managers and governing boards eventually came to recognize that building and maintaining effective channels for the diffusion of technology would take substantial funding, just as marketing does in the purely commercial sector.[139]

[139] Corey (1997). p. 108.

g. Proprietary Technology

The value of proprietary technologies seemed to vary across the industrial sector and government. Similar to regulated industries the level of corporate rivalry was found to be relatively low but so were the opportunities to secure some type of competitive advantage through the development of new and/or proprietary technologies.

Partnerships via CRADAs were another very productive initiative for consortiums. Hundreds of agreements with industry had been negotiated with both large and small companies. It was remarked, "CRADA ventures may well have the potential of developing patentable proprietary technology of benefit to corporate funders in the pursuit of competitive advantage."[140]

h. Fees

Consortia typically had membership fees that varied according to a firm's size. These fees were set and imposed by a core governing group. These fees were, in effect, "taxes" imposed on the members to support some portion of the program. The fact that this support is mandated implies that the governing bodies thought it was unlikely that it would be supported voluntarily. The incentive to form a collaborative group is largely economic and the incentive typically comes from a group where the anticipated net benefit is estimated to exceed the anticipated total cost of the venture.

i. Government Involvement

One of the conditions for continued participation in a consortium arrangement was found to be a 'high level of expertise in the formation and management' of the consortia. A review of the successful consortia studied reveal they were formed to serve as instruments of national policy or as integral parts of private enterprise. Furthermore, all of the successful consortia came from private industry. The government-funded consortia, in the US, Europe and Japan, had failed to meet expectations. Within the US there have been exceptions to this rule, notably DARPA and NIST consortia arrangements. Part of the problem appears to be that government involvement caused such groups to have multiple goals. While some of the goals were

140 Corey (1997). p. 118.

clearly economic, others were political. In some cases the goals were not closely aligned with the consortia member interests.

Those consortia that were heavily funded by the government were also very vulnerable to sharp budget cuts and shifts in public policy, national income and political priorities.

Within such organizational structures the projects selected were required to benefit existing customers and this stipulation discouraged projects which might address new markets and pursue new customers.

In the private-sector these consortia are formed as a result of economic incentives that exist for some potential membership. Mission statements are focused and unambiguous and they survive as long as they continue to fulfill the needs of the members.

I. CHAPTER SUMMARY

This chapter provided background information to lay the foundation for the issues raised throughout the remainder of this thesis. With respect to the broad issue of technology transition, the notion of whether the government can operate in a more business-like manner was shown to be a highly complex matter. As the issue was explored it was seen to be a highly interrelated mix of issues such as military-civilian relationships and organizational structures that require careful examination in order to resolve the relevance and interdependencies among many of the important issues explored. Of particular relevance to the FNC Process is the experience of the R&D consortia in their perception and use of technology demonstration processes.

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III. DON SCIENCE &TECHNOLOGY PROGRAM

A. INTRODUCTION

This chapter presents an overview of the Department of the Navy (DoN) Science and Technology (S&T) Program. The DoN S&T Program encompasses a number of individual subcomponents, one of which is the Future Naval Capability program. This chapter is an extension of the literature search presented in Chapter II but provides increasing detail with respect to the DoN S&T Program. For the reader, this general description of the goals and objectives of the S&T Program is necessary in order to appreciate the range of issues which can and do impact decisions made at the FNC level.

The information presented here is not analyzed for technical content but is simply presented as the state of the S&T Program at the time this research was conducted. The information presented has been drawn from a variety of public documents and attempts to reflect, as accurately as possible, the objectives of the S&T Program through 2003.

B. BACKGROUND

The Office of Naval Research (ONR) was established by Public Law 588 in 1946[141]. The role of ONR is to plan, foster and encourage scientific research because of its importance to future naval power and the preservation of national security. Naval research activities were to be conducted in augmentation of and in conjunction with the research and development conducted by other offices and agencies of the Department of the Navy.

The Chief of Naval Research (CNR) is the Navy's science and technology executive officer and the Office of the Chief of Naval Research (OCNR) was established in 1986[142]. CNR responsibilities spanned the Office of Naval Technology (ONT) and

141 Act of 1 Aug 1946, Public Law 588, 79th Congress (10 USC 5021-5024)

142 SECNAVNOTE 5430. 29 September 1986.

were later expanded to include the mission and function of the Office of Advanced Technology (OAT), and the Office of Research and Development Center Policy (ORDCP)[143].

The OCNR functions and responsibilities were revised and updated in 1991[144]. The Office of Naval Research (ONR) was reconstituted in 1992 with additional changes to its role and responsibilities. Changes made included the integration of ONR, ONT and OAT functions into ONR, the designation of the Naval Research Laboratory (NRL) as the Navy Corporate Laboratory and subsequent changes to ONR responsibilities relative to other Navy SYSCOM R&D Centers[145].

Under these changes a sampling of the responsibilities of the ONR as defined by these DoN notices and instructions includes:

- Serve as the Responsible Office for the Navy RDT&E appropriation.
- Assess, promote, coordinate and manage naval basic research, exploratory development and advanced technology development, directed at transitioning new capabilities toward fleet utilization and increased naval warfare capability.
- Policy, oversight, and execution management for programs funded in the 6.1, 6.2 and 6.3A Research, Development, Test, and Evaluation, Navy (RDT&E, N)[146].
- Maintain liaison regarding research and technology necessary to meet requirements for future fleet operations and capabilities.

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143 Defense Management Report Implementation Plan. 2 October 1989.

144 Office of the Chief of Naval Research, SECNAV INSTRUCTION 5430.20D. 7 March 1991.

145 Office of Naval Research, SECNAV NOTICE 5430. 4 December 1992.

146 The DoD divides its RDT&E into seven Budget Activity (BA) categories, each of which being designated by a numerical code: Basic Research (BA1), Applied Research (BA2), Advanced Technology Development (BA3), System Demonstration and Validation (BA4), Engineering and Manufacturing Development (BA5), Management Support (BA6) and Operational Systems Development (BA7). For the DoD, the “Science and Technology” (S&T) component of the RDT&E budget comprises the BA1, BA2 and BA3 accounts. In the past the BA1 (Basic Research) category has been referred to as “6.1,” BA2 (Applied Research) has been referred to as “6.2,” and BA3 (Advanced Technology Development) has been referred to as “6.3.” The numerical taxonomy (6.1, 6.2, 6.3) is a carryover from past budget structures related to specific Program Elements (PEs). This can be confusing since there are “6.3” PEs in BA4 and BA5. The DoN S&T Program is responsible for BA1, BA2 and BA3 only. S&T is separate from the 6.4 and higher budget activity categories which are executed by other “claimants” of the DoN community (Program Executive Officers, Navy and Marine Corps System Command Program Managers, etc). The reference to 6.1 funds here means BA1, the 6.2 reference means BA2 and the 6.3A reference means BA3.

- Provide scientific and technical expertise to DoN and DoD by assessing foreign research and technology, assisting in solving pressing naval problems, and evaluating research and technology inputs to systems development programs.
- Develop and execute a program investment strategy with appropriate managerial and technical guidance.
- Cultivate a positive working environment between Navy S&T communities and industry to promote collaborative efforts resulting in the transfer of military technology to the commercial sector.
- Acquire and assist science and technology through a contracts and grants program. This program would provide contracting services for other Navy, DoD, and Federal activities, where appropriate, as well as responsibilities for contract management relative to educational institutions for DoD and other Federal agencies by agreement.
- Coordination and administration of scientific studies which span broad naval interests.
- Encourage and promote education in the fields of science and technology and provide financial incentive programs to increase the technical talent base available for use in the Navy, government, and other national research and development efforts.
- Collect and make available to the DoN information on S&T results, discoveries, trends in S&T activity, location and availability of scientific and technical expertise and facilities in the US and abroad.

The ONR is a Headquarters Command. As such it does not necessarily (or typically) perform the scientific research and technology development with its own personnel. As delineated by the above guidance it performs administration and technology coordination services for the DoN and, with respect to joint efforts and operations, for the DoD. The primary means for the conduct of these duties is through issuing contracts, grants, scholarships to academia, industry and a consortium of RDT&E facilities within the S&T community. One such naval S&T consortium is the Naval Research Enterprise (NRE) which is made up of the Naval Research Laboratory (NRL), the Navy SYSCOM Warfare Centers, and Federally Funded Research and Development Centers (FFRDCs). Generally speaking, it is the employees of this wider consortium of NRE researchers, scientists and technologists that conduct the DoN S&T work on behalf of the ONR.

C. REPORTING STRUCTURE

As the S&T Executive for the DoN the CNR reports to the Secretary of the Navy through the Assistant Secretary of the Navy for Research, Development and Acquisition (ASN (RD&A)). To perform his appropriation responsibilities the CNR is "dual-hatted" as the DoN Resource Sponsor for S&T (OPNAV N091). The CNR reports to the Chief of Naval Operations (CNO). Figure 2 diagrams the CNR's reporting chain of command.

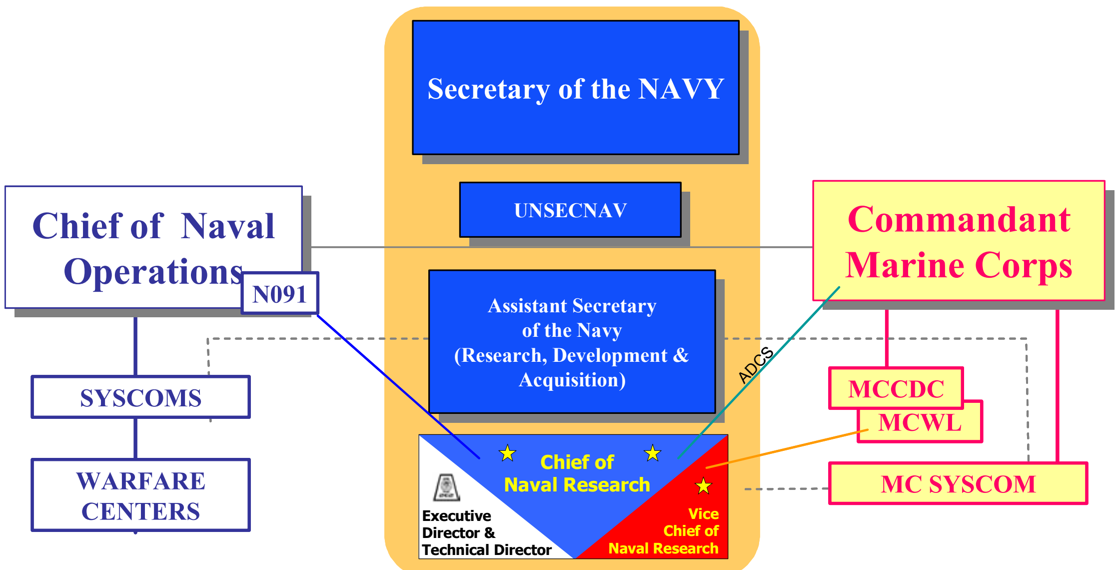

Figure 2. Reporting Chain of Command

1. Marine Corps Command

The Marine Corps (MC) has a unique relationship within DoN S&T through mutual reporting arrangements. The Commandant of the Marine Corps provides a general officer to ONR with responsibility as the Vice Chief of Naval Research (VCNR). The VCNR is a full partner in the leadership team at ONR. The Commandant of the Marine Corps also assigns the CNR with the responsibility of Assistant Deputy Chief of Staff for S&T, a member of the Marine Corps General Staff. This relationship was strengthened by the formal transfer of program management and fiscal responsibilities and personnel billets from the MC Systems Command (MCSC) to ONR in 1999.[147]

[147] The USMC/ONR S&T Integration activities were conducted over a several year period. Initial USMC/DoN RDT&E responsibilities were documented by an MOA dated 29 November 1995. A senior leadership meeting occurred on 4 February 1999 and 24 May 1999 with the terms of the agreement were documented in a Memorandum for the Record dated 16 July 1999.

D. PROGRAM COMPONENTS

The DoN S&T Program can be approximated as two primary program components; a long-term, research-oriented, "Discovery and Invention (D&I)" component and a more near-term, application-oriented, "Exploitation and Deployment (E&D)" component. DoN S&T execution resources (BA1, BA2 and BA3) are roughly equally split among these two programs.

The level of investment for the DoN S&T Program is roughly set at 2% of Navy TOA. This level of investment falls below the levels suggested by OSD guidance (3% of Navy TOA) and is far lower than representative investment levels from the commercial sector as well as other non-defense technical sectors within the government.[148]

1. Discovery and Invention

The Discovery and Invention (D&I) component of the DoN S&T portfolio addresses long-term naval needs. The D&I portion of the Navy's S&T program is resourced from the BA1 (Basic Research) and about half of the BA2 (Applied Research) accounts. The intent of the S&T program is to focus this portion of the investment portfolio on long-term scientific research and the generation of new concepts and ideas. The exact definition of "long-term" is somewhat vague but it always implies programs with expected utility beyond the Future Years Defense Plan (FYDP), or current budgeting horizon. This component of the S&T portfolio is sometimes referred to as the "Navy and Marine Corps After Next"[149].

ONR's fundamental approach to "Discovery and Invention" emphasizes the financial support of a very large number of research avenues to understand basic

[148] This comparison roughly equates Navy S&T investment levels (BA1/2/3, a subset of the RDT&E investment) to commercial R&D investment levels. This comparison is assumed reasonable since acquisition investments (BA4+, the rest of the RDT&E investment) are roughly equated to commercial production activities, which are not included in commercial R&D figures. For 2002 data, non-government R&D investment levels are significantly higher that defense S&T investment levels. For example, pharmaceuticals invest at 14.2%, software publishing at 12.9%, semiconductor manufacturing at 11.9% and computer design at 10.4%. Within the Federal government navigation and control industries invest at 5.2%, aerospace at 4.3% and scientific services invest at 2.3%. This is a summary of NSF data from URL = http://www.nsf.gov/sbe/srs/infbrief/nsf04320/start.htm. Last accessed June 2004.

[149]The terminology of a "Next Navy" and a "Navy After Next" is taken from Paul Bracken, "The Military After Next", The Washington Quarterly, 1993, 16:4 pp 157-174.

scientific principles and the accumulation of fundamental knowledge across a wide number of disciplines which have potential Navy relevance. Such an approach allows the Navy to "buy-in" to a research area to assist and leverage significant advances being made by others interested in those science and technology fields as well. Much of this work is academic in nature and is accomplished through grants and scholarships to major universities and industry. Major research programs are usually in technical areas with specific naval interest (underwater weapons, acoustics, etc). There are also areas of continuing research interest where there is a desire to maintain our national strengths in areas that are uniquely naval in nature.

The D&I program is organized into technology research "thrust" areas. ONR "thrusts" are integrated programs designed to foster innovation in a scientific or technological discipline (e.g. nanoelectronics, computational methods) or a discrete system concept or capability (e.g., underwater weaponry, combat casualty care). There are two parallel sets, one describing the in-house programs of the corporate Naval Research Laboratory (NRL) and the Warfare Centers (ILIR, etc.), and the other the external programs managed by the individual ONR S&T Departments. NRL thrust areas are supported by a core 'technology base' allocation of resources provided to NRL by ONR.

Inputs to the D&I program come from two primary internal concept-generation processes; National Naval Responsibilities (NNRs) and Grand Challenges (GCs). The NNR and GC processes each identify areas of high naval priority for future technology developments.

2. Exploitation and Deployment

The Exploitation and Deployment (E&D)[150] component of the DoN S&T portfolio responds to near-term naval needs. The E&D component of the Navy's S&T program is resourced out of the remaining half of the BA2 (Applied Research) account as well as most of the BA3 (Advanced Technology Development) account. This portion of

[150] The "Exploitation & Deployment" phrase for the more applied half of the S&T Program is not used as often as the "Discovery & Invention," the terminology for the research half of the S&T Program.

the S&T program has a much more immediate (short-term) warfighter emphasis as well as a significant focus is on demonstrating technical capabilities and transitioning these naval capabilities into acquisition programs and fleet operations. Programs funded as a part of the E&D portfolio have expected utility within the Future Years Development Program (FYDP) and should be a part of the POM planning and budgeting process. This component of the S&T portfolio is sometimes referred to as the "Next Navy."

The D&I thrusts projects in priority Research Areas provide the foundation of knowledge and limited concept definition and supporting technology development. These thrust areas are then assessed and prioritized for further refinement and development within the E&D component of the S&T product development model. Customer-focused programs, such as the Future Naval Capabilities (FNCs)[151], make up a major part of the E&D component of the DoN S&T program. Projects supported within the E&D's FNC program have all been approved and prioritized by a series of Integrated Product Teams (IPTs) that consist of senior Navy and Marine Corps leaders. Ultimate FNC 'portfolio' approval is provided by a Navy S&T Corporate Board. This Corporate Board consists of the Assistant Secretary of the Navy (Research, Development and Acquisition) (ASN(RDA)), the Vice Chief of Naval Operations (VCNO), and the Assistant Commandant of the Marine Corps (ACMC).

3. Program Integration and Flow

Figure 3 illustrates the typical S&T product development model process flow. Concepts are fed into the D&I (BA1/BA2) component and as the knowledge is understood and developed it is moved into a higher BA category for more advanced and more naval-focused development and demonstration. The number of projects supported are reduced as they mature and progress to higher BA categories but the level of investment goes up accordingly due to increasing integration costs. Projects that are sufficiently developed and show naval relevance are integrated into naval capability demonstrations. In this model successful naval project demonstrations should

[151] The Future Naval Capability technology transition process will be addressed in greater detail in the next chapter of this thesis.

"transition" from the Navy's S&T Program into an Acquisition program (BA4 and higher) desiring the demonstrated naval capability (either an entirely new naval capability or an incremental upgraded capability).

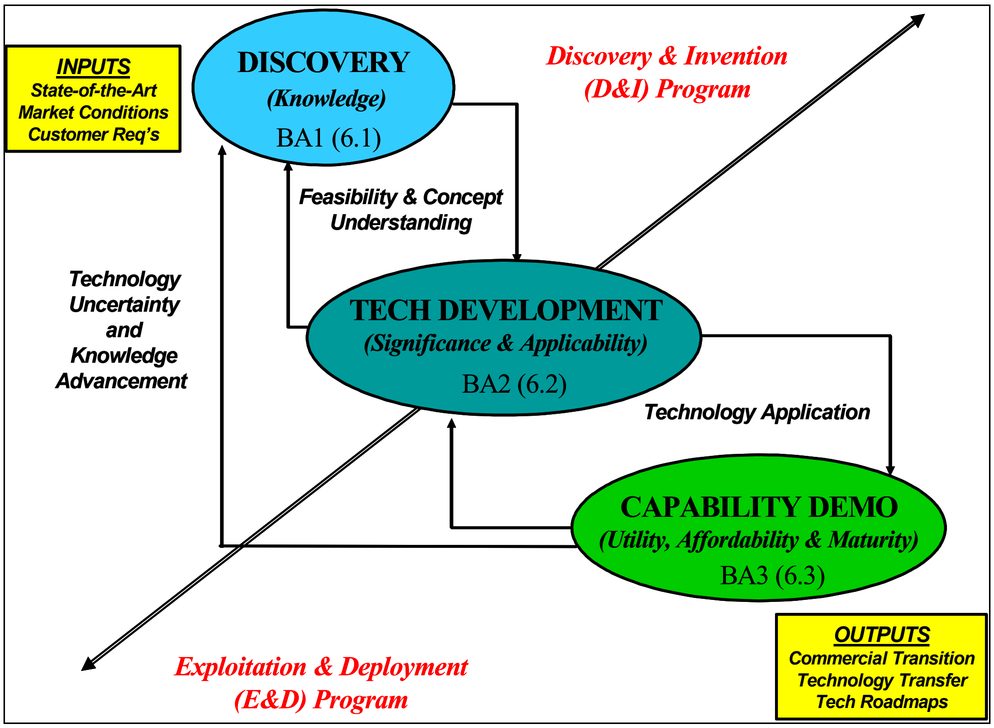

Figure 3. The S&T Product Development Process

4. S&T Community Partnership Outreach

ONR has established a number of "outreach" offices to foster and maintain constant interaction and dialog with a variety of customer representatives. This dialog helps ONR keep abreast of issues, problems and concerns from the various naval communities across the US and throughout the world. This dialog provides ONR with needed feedback and insight regarding their S&T processes. Typically these outreach offices have very small staff, which may be augmented by personnel from other naval commands and agencies. These offices generally do not directly manage Navy S&T projects.

a. *Science Advisors*

The ONR administers the selection and assignment of a number of technical Naval Research Science Advisors (NRSAs) to naval commands throughout the world through the Naval Fleet/Force Technology Innovation Office (NFFTIO). The NFFTIO provides a common interface among the NRSAs, the recipient Navy and Marine Corps Fleet/Force commands, and the body of technical experts employed by the various Naval Research Enterprise (NRE) facilities.

Naval Research Science Advisors (NRSAs) are assigned to staff of the Navy and Marine Corps Fleet/Force commands for a two-year developmental assignment. As part of their S&T advisory duties the NRSAs help to clarify and identify the S&T needs of the Fleet/Force and serve as an interface in finding and implementing technological solutions. As members of the Commander's staff, the science advisors develop important relationships with the warfighters and facilitate an increased requirements, science and technology dialog between the warfighter and headquarter communities. The long-term assignment helps to assure that current naval warfighting needs are understood and accurately reported back to the S&T community.

b. *International Field Offices*

ONR staffs a small International Field Office (IFO). IFO operations provide ONR with a convenient access into the international scientific and technical community. With an increasing emphasis on leveraging technical contributions of our allies as well as the need for greater coalition interoperability capabilities the IFO operations provide ONR with an opportunity to nurture technical exchanges and collaboration possibilities with the global S&T community.

c. *SYSCOM Liaison Office*

ONR has established a headquarters liaison office with the Navy's Systems Commands. This S&T Liaison Office (STO), consisting of representatives from NAVAIR, NAVSEA, SPAWAR and CNET[152], help to facilitate a continuous cross-community S&T dialog regarding administrative and technology transition issues in

[152] The CNET (Chief of Naval Education and Training) designation has recently been changed to NETC (Naval Education and Training Command).

support of general S&T transition efforts[153]. The liaison activities promote a direct interaction between the S&T and acquisition communities to foster the development of a coherent, sound and effective S&T program that is consistent with the needs, guidance and priorities among the various naval acquisition communities, operational requirements and DoN S&T resources.

d. Program MOU/MOAs

In order to maintain a continuous, accurate dialog in support of S&T coordination activities with other program offices within the DoN, DoD and defense agencies ONR establishes other operating agreements, as appropriate. At present count there are roughly 50 active Memorandum of Understanding (MOUs) and/or Memorandum of Agreements (MOAs) in force. These MOU/MOAs provide increased visibility in the DoN S&T Program as well as formal agreement in research activities, increased technical collaboration and the leveraging of external agency resources for mutual benefit.

e. Cooperative R&D Initiative

There are some programs within the overall DoN S&T Program that appear to operate in a businesslike manner, meaning they generate revenue for the Navy. One such example is the Navy's Cooperative Research and Development Agreement (CRADA) program. Although not large, the CRADA program generates a small amount of revenue. The revenue flows from corporations to the government, typically the NRE Warfare Centers and Laboratories, because the quality of the research or the access to naval expertise is considered to be of significant value to those companies. The number of CRADAs initiated by our Warfare Centers is small, on the order of 120 a year, and the percentage of those that actually generate revenue for the Navy is also small (approximately 25% of the total) as is the amount of revenue generated (on the order of $1M total across all CRADAs in any given year) but the fundamental approach is relatively unique within Navy operations.

[153] Each of the acquisition communities negotiate separate Memorandum of Understandings (MOUs) with ONR. For example the original NAVAIR MOU was dated 15 June 1994, and the SPAWAR Lettter of Understanding (LOU) is dated 30 April 1996.

5. Laboratory Structure

The Naval Research Laboratory (NRL) is the Navy Corporate Laboratory and primarily conducts Basic and Applied Research for the DoN. NRL is a member of a larger Navy Laboratory system which includes the various Naval Systems Command Warfare Centers. The NRL and Navy Warfare Centers are collectively part of an even larger naval RDT&E community referred to as the Naval Research Enterprise (NRE). The NRE consists of members of the research, development and test, and evaluation communities such as ONR, the Naval Research Laboratory (NRL), the Systems Commands (SYSCOMs) and their associated Warfare Centers, Naval Medical Laboratories, and the Federally Funded Research Development Center. The NRE conducts the majority of the Naval S&T research and development and also assists in the recruitment of Science Advisors.[154] Figure 4 shows the distribution of Navy's laboratories across the country.

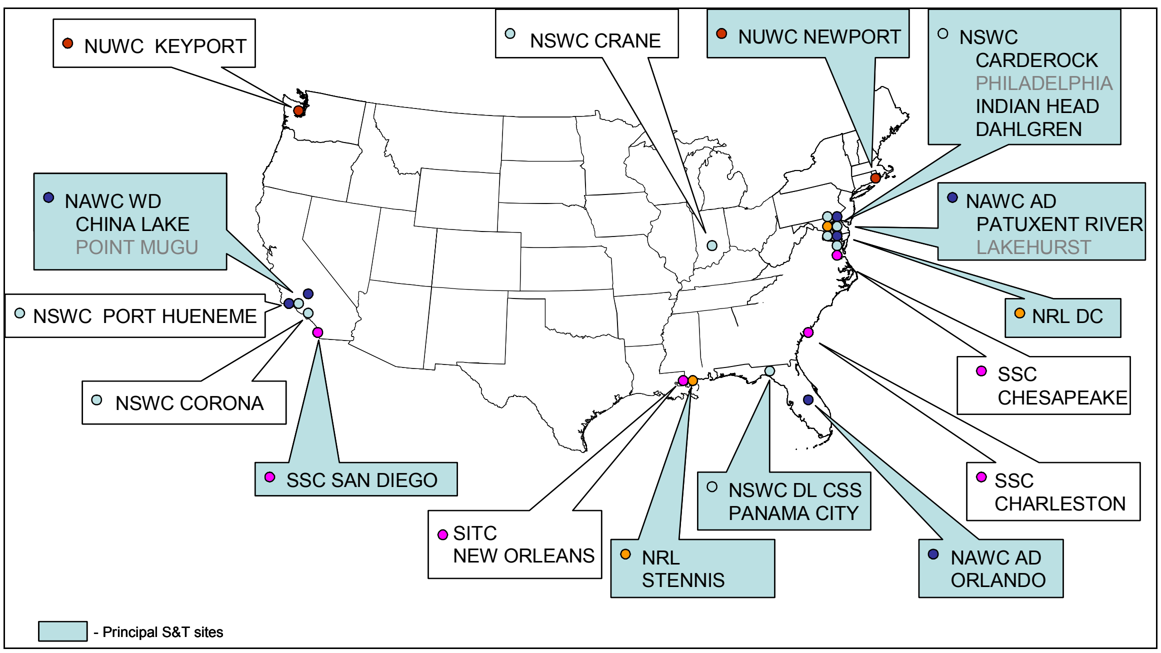

Figure 4. Navy Laboratory and Warfare Center Community

154 URL = http://www.onr.navy.mil/ctto/nre_description.asp, accessed June 2003.

6. S&T Program Inputs

DoN S&T Strategic Guidance is captured in several ways. A primary means is through the selection, approval and support of a few high-priority technical areas of unique naval interest. These are two primary areas of input; National Naval Responsibilities (NNRs) and Grand Challenges (GCs). These investment areas are research fields that are considered either to be unique to the Navy and critical to successful Navy operations. By its nature this research supports fundamental naval capabilities that would not be supported outside of the naval community.

7. National Naval Responsibilities

A National Naval Responsibility (NNR) is a scientific area uniquely important to the Navy and Marine Corps and critical to Navy/Marine Corps wartime operations. Because of their unique naval nature the NNR areas require significant Navy investment since no other Service or Defense Agency will have a need to invest in these areas themselves. Potential NNR topic areas are analyzed by ONR and boards of the National Research Council. At the current time there are three NNR topic areas: Ocean Acoustics, Underwater Weapons, and Naval Engineering.

8. Naval S&T Grand Challenges

Navy S&T Grand Challenges (GCs)[155] are long-term, highly challenging scientific and technical objectives that are being addressed by a focused series of related research efforts over a very long (20 year +) time frame. Solving these Naval S&T GCs will help to enable future Navy and Marine Corps warfighting capability options that may be required by the "Navy After Next." By emphasizing selected ongoing research and by introducing appropriate long-term research into our present R&D program, we can develop the capabilities that will be required for the future.

Using a small panel of experts from ONR and NRL, a list of eight Naval S&T Grand Challenges were developed. The GC thrust areas are either technical or operational in nature and have high level objectives regarding risk, excitement, and

155 URL = http://www.onr.navy.mil/sci_tech/grandc.htm, accessed July 2003.

motivational value. The selected GCs have been approved by CNR and are being promulgated in the Navy and Marine Corps R&D community to provide long-term focus and program guidance for the DoN S&T Program. ONR's Chief Scientist periodically reviews the future progress of the Naval S&T Grand Challenges and initiates changes to the GC on a three year cycle. The four Naval S&T Grand Challenges are:

a. Naval Battlespace Awareness

The challenge is to describe the current and future Naval battlespace in terms of the natural environment (space, atmosphere, ocean and the nearby land masses) and the disposition of friendly and enemy forces, with sufficient detail, accuracy, and timeliness to meet evolving Navy and Marine Corps mission requirements.

b. Electric Power Sources for the Navy and Marine Corps

The challenge is to develop new sources of power for the "Navy (and Marine Corps) after Next." The future power requirement for the Marine Corps is that of a portable long-lived power source which can provide power for all Marine-carried equipment. The primary electric power source required for all electric ships and other Naval warfighting platforms must employ a non-petroleum fuel and must be safe, efficient, and have little undesirable emissions.

c. Naval Materials by Design

The challenge is to develop, beginning from first principles, computational procedures which will yield the composition, synthesis and processing recipes for required naval materials with superior properties, in a time frame of system development.

d. Multifunctional Electronic Systems for Intelligent Naval Sensors

The challenge is to develop highly multifunctional nanoscale architecture devices to their ultimate limits of high speed, small size and low power. These future systems will interactively combine sensing, image processing, computation, signal processing, and communication functions, to achieve real-time adaptive responses. The future implementation of these systems using devices of nanoscale architectures are envisioned to realize terahertz digital processing speeds and ultra-low power consumption.

9. Transformational Technology Transition Activities

The difficulty of the S&T "transition" process is enormous and has been recognized by many. At the DoD level a number of programs have been initiated in an attempt to address this issue and the DoN supports these DoD initiatives with its own, naval-focused, technology transition initiatives and programs. The DoD, for example, continues to use the "Advanced Technology Demonstration" (ATD) and "Advanced Concept and Technology Demonstration" (ACTD) programs as its primary vehicles to transition technologies. Both of these programs have demonstrated only mixed success over the years. For the Navy the ATD program was replaced in FY02 by the Future Naval Capability (FNC) process.

a. Tech Solutions

Tech Solutions is a relatively new S&T initiative that intends to solicit real-time input from Sailors and Marines regarding fleet problems that need immediate technology solutions. The "Tech Solution" model allows inputs to be received from the warfighter through a "reverse eBay" website[156] where they are vetted across Navy NRE solution providers such as the Naval Warfare Centers, NRL, and Applied/University Labs looking for potential technology matches. This program attempts to provide rapid S&T solutions to the warfighter.[157] The approach is to provide Sailors and Marines web-based access to the expertise of the Naval Research Enterprise. This access, via both internet and a secure military internet, targets E-4s to O-4s who work daily at the deckplate/ground level on ways to improve mission effectiveness through the application of technology. Improvements from this effort are intended to help move the Navy toward its goal of a more effective and efficient use of personnel.

ONR's goal is to provide the Fleet/Force with prototypes that deliver "50–70% solutions" addressing immediate requirements and that can be easily

[156] eBay is an internet auction service that claims to host millions of auctions at any given time. This service is considered highly innovative due to its low overhead and inventory requirements as well as its ability to service millions of remote users simultaneously through the use of computer information technologies. The eBay success story is based on the premise that if someone wants to sell something they can easily find buyers anywhere in the world using the internet. For additional information on eBay refer to the official eBay tutorial website, URL = http://pages.ebay.com/education/. Last accessed June, 2004.

[157] For additional information on ONR's "Tech Solutions" business process refer to ONR URL = http://www.techsolutions.navy.mil/. Last accessed June, 2004.

transitioned by the acquisition community. To accomplish this Tech Solutions structures every project with definable metrics and includes appropriate Systems Command elements in an Integrated Product Team concept. This approach was used to help ensure that technology transition "hook points" would be built into the solution in order to trigger the acquisition authority executives to move directly to final prototyping or a decision to buy.

b. Swamp Works

Swamp Works is another "transformational" initiative intended to push the envelope of S&T in search of technology breakthroughs that can benefit the operational Navy in the very near term (within 1-3 years) rather than the much longer time frame of more conventional technology development experiences (15-20 years). Swamp Works is being thought of as a small program that will look for truly innovative and "out-of-the-box" solutions to the most pressing Naval problems. Swamp Works initiatives are considered very high-risk with the possibility of very high payoffs, if successful. These initiatives are intended to address "disruptive technologies" to achieve breakthroughs and create "leap-ahead" naval capabilities in weapons, sensors, platforms, and warfighting.

c. Venture Capital

ONR's Commercial Technology Transition Officer (CTTO) has pursued a "venture initiative" as a possible (rapid) alternative to our current conventional (slow) acquisition processes. The goal of this venture initiative is to explore technology transition processes modeled after commercial venture capital practices and adapt those that show the most promise.

Under this initiative there were two technology transition "wargame" exercises conducted. These venture wargames are an attempt to explore opportunities for sharing technology with the commercial marketplace. These wargames, with participants drawn from the government, industry, and the private venture capital community, explore possible opportunities for venture initiatives that would facilitate the introduction of innovative technologies from commercial industry into the naval services. Initial indications are that the ability to "broker" information and deals among interested

government program managers, intellectual property holders, and venture capitalists may offer a promising approach to a faster transition of innovative technologies than conventional approaches.

E. SUMMARY

This chapter presented a brief overview of the Department of the Navy (DoN) Science and Technology (S&T) Program. The DoN S&T Program was shown to consist of a number of subcomponents including the Discovery and Invention (D&I) program and the Exploitation and Deployment (E&D) program (where the Future Naval Capability process is contained). The integration and flow of the S&T program components was discussed as well as other relevant elements of the S&T program including ONR's S&T community outreach efforts (the use of fleet science advisors and SYSCOM liaison officers) and the DoN NRE laboratory structure.

The ways in which inputs are provided to the S&T Program was discussed and a summary of a few of the major S&T investment interest areas, National Naval Responsibility and Grand Challenges, were provided. Finally, a few of the most recent transformational process initiatives, formulated under the current CNR, were summarized.

IV. FUTURE NAVAL CAPABILITIES

A. INTRODUCTION

This chapter provides a description of the Department of the Navy (DoN) Future Naval Capability (FNC) process. The information presented here is an extension of the general literature review presented in Chapter II and the overview of the DoN S&T Program presented in Chapter III. The stated goals and objectives of the FNC Process are described as well as the (approximate) chronological sequence of events, from memorandums and other guidance documentation collected, as they unfolded and the FNC Process was introduced throughout the DoN S&T community of stakeholders. Because of the 'newness' of the process there was no attempt made to describe the individual FNC projects to any degree of detail nor was there any attempt made to evaluate the success or failure of individual projects.

As with the S&T overview presented in Chapter III, the information presented here has not been analyzed for its technical content but is simply presented as an accurate representation of the state of the FNC Process at the time this research was conducted. The information presented here was also drawn from a wide variety of public documents and documents the implementation of the FNC technology transition process through 2003.

This description of the implementation of the FNC Process will be informative and necessary for the reader to interpret the feedback provided by S&T stakeholder community personnel. This data will be presented in the next chapter.

B. BACKGROUND

In June 1999, the Navy approved a new investment process for the Department of the Navy (DoN) Science and Technology (S&T) Program. This new S&T investment process focused on achieving a long-term view not anticipated by currently perceived Naval needs as well as a much more intense focus on nearer-term naval warfighter capability needs. From a resources perspective this new S&T investment process divides

the S&T investment portfolio, which spans BA1 (6.1), BA2 (6.2) and BA3 (6.3), essentially in half. The long-term view is termed Discovery & Invention (D&I) and is resourced through the BA1 and approximately half of the BA2 funds. The nearer-term part of the portfolio is termed Exploitation & Delivery (E&D) and is resourced from the remaining half of the BA2 and the BA3 funds. The primary component of the E&D portion of the S&T portfolio is a new technology transition process known as the Future Naval Capabilities (FNC).

The Future Naval Capabilities (FNC) technology transition process is a new DoN S&T business model process that attempts to align and partner the Navy's Requirements, Acquisition and S&T communities to focus S&T investments to transition high-priority advanced naval capabilities to the warfighter within the Future Years Development Plan (FYDP) budgeting and planning cycle.

Under this new process approximately half of the DoN S&T budget will be focused on carefully selected investment programs; these programs will develop and demonstrate those advanced technologies that address and enable the high priority Future Naval Capabilities. Transition sponsors will be closely coupled to the FNCs to ensure that the capabilities are delivered to the fleet in a more aggressive and timely manner.

At the time of the establishment of this new S&T investment process, a list of twelve FNC emphasis areas was approved by a DoN "Corporate S&T Board." An Integrated Product Team (IPT) was formed for each FNC to provide oversight for the investment process. Led by flag level personnel, each FNC IPT defined specific Enabling Capabilities (ECs), prioritized those capabilities, performed a technology assessment and identified technology gaps, and began the development of an appropriate S&T program which will enable those future capabilities to be realized, demonstrated, and transitioned to the fleet.

C. THE FUTURE NAVAL CAPABILITY PROCESS

1. Prelude to Change

The Navy FNC technology transition process changes represent a DoN response to a continued dissatisfaction within the DoD of the Service's inability to transition developmental technologies to their operational forces as well as to the US commercial sector.

In 1998 the ASN(RDA) requested a study be conducted of the technology insertion issues. A web site was designed and an electronic "survey" was posted and made available for comment throughout June and July, 1998. The survey results were captured and analyzed with the results being briefed to the ASN(RDA) in December 1998. The Technology Insertion Process Action Team (PAT) report was part of a larger report delivered to the ASN(RDA) in Jan 1999. From their analysis the Technology Insertion PAT made several recommendations to the ASN(RDA)[158]:

- Enhance communication among stakeholder groups via annual S&T symposia
- Improve S&T coordination with acquisition program offices
- Institutionalize planning for technology incorporation
- Evaluate means for engaging all stakeholders in identifying S&T priorities
- Study better S&T incentives

2. Reasons for Change

The FNCs were established in response to the perception that S&T investments were not sufficient to enable delivery of new capabilities to the warfighter in a reasonable timeframe. As articulated by senior-level management it was felt within the Navy that there were too many programs funded for the level of resources available and, as a result, there were not enough programs funded at a sufficient level ("critical mass") to realize transitions from DoN S&T accounts (BA1 through BA3) to acquisition (BA4 and above). The ability to realize a technology transition requires a coordinated "hand-off" from the

158 PowerPoint briefing, Technology Insertion Survey Questionnaire. Results briefing to Team Six Principals, 18 Dec 1998.

S&T (BA3) to acquisition (BA4) communities. Figure 5 has been commonly used to illustrate the transition problem as being one where the S&T and acquisition community areas of responsibility do not overlap and the technology development and transition effort fails to transition by effectively falling into a perceived "valley of death."

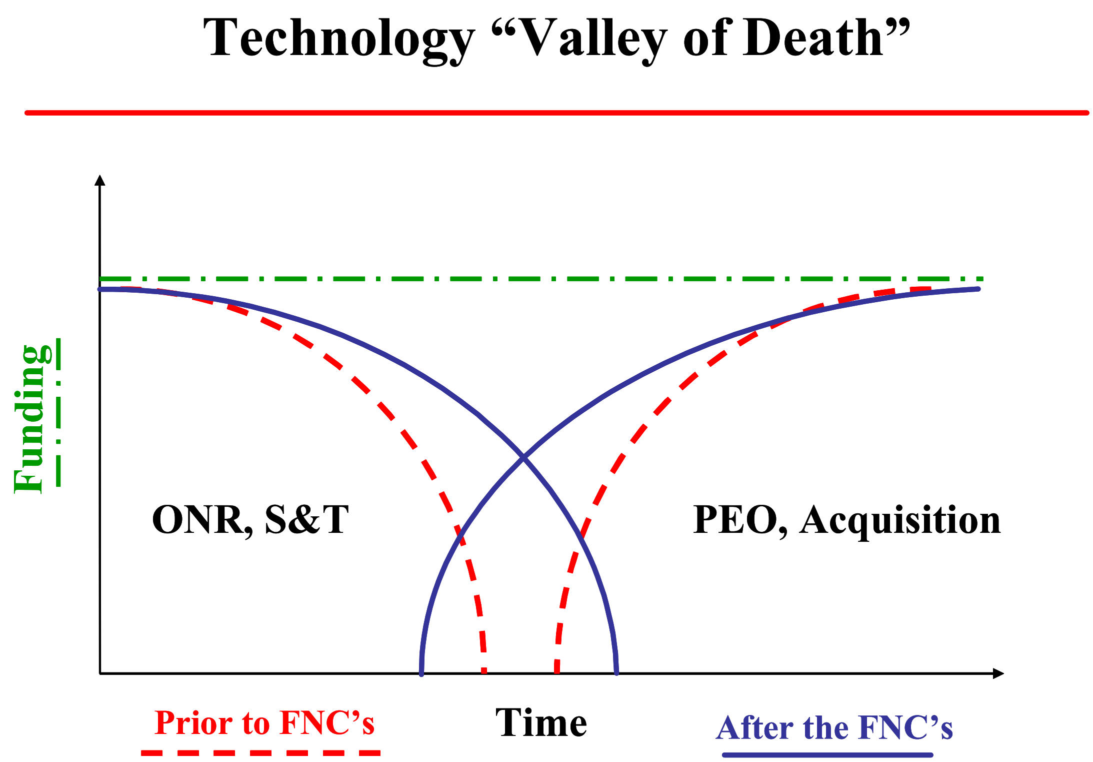

Figure 5. The Technology Transition "Valley of Death"

There was a desire to increase S&T support for high-priority Naval[159] operational requirements, to improve the number of technology transitions, and to facilitate flexible and responsible prioritization. More importantly, there was concern over whether or not the Navy's S&T account delivered anything substantial to the fleet for the (currently $1.5B) annual investments being made. There were a number of issues which fed this

[159] Navy & Marine Corps.

general concern; S&T investments were viewed as "platform centric[160]," the SYSCOMs desired to gain control over the 6.3 advanced development account, the lack of reliable commitment from the acquisition community to "pick-up" mature S&T technologies, and a trend of S&T investment resource reductions over the years.

3. Implementing Changes

In 1998, shortly after assuming "dual-hat" responsibilities as S&T Resource Sponsor (OPNAV N091) and the Chief of Naval Research (CNR), the CNR was involved in discussions with the VCNO and offered proposals for an updated S&T requirements process. These proposals, described in a 15 July 1998 letter from the CNR to the VCNO, broadly outline what is to eventually become the Future Naval Capability process. The proposals put forward by the CNR:

- Focus "requirements" determination on a prioritized list of desired future capabilities rather than technologies. A prioritized list of capabilities (vice technologies) would be provided by each OPNAV participant. This involvement of OPNAV would also provide "corporate OPNAV buy-in of the result" and "corporate prioritization" among OPNAV priorities.
- Proposed the establishment of a DoN Corporate Board to bring the VCNO and ACMC together to interleaf USN & USMC desired capabilities.
- Proposed the use of Integrated Product Teams (IPTs) to develop and oversee the technology thrusts that would result from the DoN Corp Board decisions. The IPTs would consist of appropriate SYSCOMs/PEOs, OPNAV requirement officers, ONR representatives, N091 staff and members of the S&T performing community. This IPT process was to be modeled after the NAVSEA SUBTECH, Mine Warfare Tech Team, and NAVAIR-N88 aviation IPT processes[161].

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160 A platform-centric approach implies the S&T investment decisions being made were based on traditional weapons system platforms such as ships, satellites and aircraft, rather than being based on warfighting capabilities. One criticism of a platform-centric approach is that such an investment portfolio strives to maintain the "status-quo" and can be viewed as "plusing-up" acquisition programs of record. Another criticism of a platform-centric investment strategy would be that history has shown that such traditional approaches have rarely developed and delivered new and innovative solutions to warfighting problems.

161 The Advanced Technology Review Process (ATRB) is a PEO (acquisition) driven process that reviews technologies applicable to aviation mission areas. In 1998 the ATRB process was an F18-centric process (Strike Platforms ATRB) but has since been expanded to six active areas with two additional review boards in the planning stages. Although a NAVAIR initiative, and launched by Aviation PEOs, the ATRB process is intended to be a cross-SYSCOM technology review board process.

- Proposed a restructuring of the S&T program into two equal parts which would consist of, essentially, "requirements pull" and "technology push" components. The "requirements pull" portion of the S&T program would comprise "40+% of program; weighted towards 6.3" and a roughly equal "40+%" part of the S&T program would be made up of the "less applied part of the program (6.1 and some 6.2) to prepare for DoN future capability needs."
- Make the 6.3 S&T program "demo-centric" and focus on demonstrations of different sizes as the S&T exit criteria. The comment was made that "History shows that it is best to minimize lumping all demos into special programs that are easily targeted like ATDs, ACTDs."

The proposed requirements process would look for efficiencies in S&T management between the ONR and N091 organizations while striving to maintain POM and execution/planning division of labor. The thrust of the proposed changes was intending to get from both organizations what they each do best:

- OPNAV: articulating and prioritizing its capabilities
- ONR: picking the technologies and performers to most affordably meet the desired capabilities.

The proposed process changes were envisioned as being more difficult for N091 but would result in less paperwork and a higher level of participation for the participating OPNAV requirements officers and technologists. The observation was made that "unless S&T funding skyrockets, we must decide to concentrate on fewer things rather than satisfying everyone a little."

These proposed Navy changes received the immediate attention of the ASN(RDA) who requested the CNR prepare an annual report on the funding balance between the two components of the proposed S&T program. In his letter to the CNR the ASN(RDA) commented:

> While your proposal focused on the "40+%" of the program that is most applied, I want to ensure that future Naval Science and Technology investments continue to look beyond just the currently desired capabilities.[162]

[162] ASN(RDA) Memorandum for the CNR, *Science and Technology Requirements Process*, 19 Aug 1998

This requested report, which was also to include a brief appraisal of the core basic and applied research efforts that are considered "national naval responsibilities," shows the high level of Navy leadership interest and, possibly, some concern that proposed S&T program changes would have a detrimental affect on long-term naval interests.

In November 1998 the VCNO issued a memorandum expressing satisfaction with OPNAVs "collaboration on a revised Science and Technology (S&T) requirements and program formulation process[163]." In this memorandum the VCNO requested that the S&T program revision efforts be integrated with OPNAV N81's new Integrated Warfare Analysis and Requirements (IWAR) process and articulated four critical attributes that the new DoN S&T process would have to meet:

- A process involving senior DoN leadership that determines and prioritizes about ten desired future naval capabilities.
- An integrated process team (IPT) approach with working groups led by OPNAV requirements codes to set requirements for the desired future naval capabilities and promote S&T program transition.
- The creation of an S&T program encompassing about 50% of the S&T budget that addresses the ten desired future capabilities.
- A review of that portion of the S&T program focusing on the ten future capability areas. The review should involve IPTs which include representatives from the fleet, OPNAV, SYSCOMs/PEOs, and Navy laboratories. The results of the review should be presented annually to senior DoN leadership.

The separate OPNAV communities each responded independently to a N091 request for the identification of desired naval capabilities. The Air Warfare Division (OPNAV N88), for example, provided OPNAV N091 with a prioritized list of 57 desired capabilities[164] which were generated during a series of S&T workshops at Fort Belvoir[165].

[163] VCNO Memorandum for the Director, Test and Evaluation and Technology Requirements, *Department of the Navy (DoN) Science and Technology Requirements Process*, 2 Nov 1998

[164] The 57 required aviation capabilities is referred to as the "Heinz 57" list.

[165] Memorandum for Director, Test and Evaluation and Technology Requirements (N091), *Science and Technology Prioritized Capabilities*, 16 Nov 1998

The OPNAV N091 staff collected the prioritized future capability requirements and binned them into potential "future naval capability" focus areas of investment. In addition to the OPNAV Resource inputs the N091 staff used the Fleet's 17 Command Capability Issues (CCIs) for an initial starting point. Original thoughts were to have 17 FNC's, one to address each Fleet CCI. To provide additional flexibility the headings for the CCIs were used but the descriptions (requirements definition) were not. Senior Navy management felt 17 technical focus areas were too many and there was a desire to reduce the number to approximately 10 focus areas. After much DoN and N091 internal deliberation the final number of 12 FNC focus areas was settled upon. The original twelve FNC technical focus areas were:

- Autonomous Operations (AO)
- Capable Manpower (CM)
- Decision Support Systems (DSS)
- Expeditionary Logistics (ExLog)
- Information Distribution (ID)
- Littoral Anti-Submarine Warfare (LASW)
- Missile Defense (MD)
- Organic Mine Countermeasures (OMCM)
- Platform Protection (PP)
- Time Critical Strike (TCS)
- Total Ownership Cost (TOC)
- Warfighter Protection (WP)

This new requirements process was built around a consensus-based Integrated Product Team (IPT) process. The VCNO issued an action memorandum directing support of the process and assigning a leader and co-leader for Navy requirements for each of the IPTs. Per this guidance the requirements leader would be the chair for each IPT and while the IPTs would be "consensus-based bodies, the chair establishes IPT agendas, schedules and meeting locations with assistance from the OPNAV (N091) executive secretary." The IPT representatives would be Flag rank military or civilian leaders from within their offices with alternates being at the appropriate pay grades.

In a similar manner the Principal Deputy for ASN(RDA) issued a memorandum assigning a leader and co-leader for the Navy and Marine Corps acquisition position within the IPT[166]. This memo also noted that IPT representation was approved for the Bureau of Medicine (BUMED), the Chief of Naval Education and Training (CNET) and the Marine Corps Combat Development Command (MCCDC). These organizations, although not formally considered acquisition commands, were approved for IPT participation due to their technology transition potential.

A joint memorandum, issued by the VCNO and the ACMC, formally announced the Future Naval Capabilities S&T Process and distributed the IPT Charter[167]. The IPT Charter identified several objectives of the new process:

- IPTs will operate on a consensus basis
- IPT members represent their entire appointing community
- IPTs will review and focus the Capability
- Chair leads IPT in the defining and prioritizing capability goals
- IPTs will describe programs in terms of project deliverables
- Capability to be delivered, time, acquisition or development opportunity
- There would be no *a priori* limit to funds
- Projects must be clearly prioritized
- Demonstration/Deliverable goals: 20% 1-2 years, 60% 3-5 years, 20% 5-7 years
- Highlight "fact of life" barriers to change (e.g. known congressional interest items, OSD commitments, ramps)

In a memo the Director, T&E and TR/Assistant Deputy Commandant (S&T)/CNR presented the S&T Corporate Board[168] with specific information on the prioritized capabilities developed for the twelve FNC IPTs. Concerns expressed at this point were that the enabling capabilities would represent true Navy needs of the future rather than "simple extrapolations of the current S&T program nor repairs of acquisition

166 ASN(RDA), Memorandum for Distribution, Future Naval Capabilities Based Science and Technology Process, 22 June 1999

167 VCNO and ACMC Joint Memorandum for Distribution, Future Naval Capabilities Based Science and Technology Process, 1 July 1999

168 The first meeting of the Navy S&T Corporate Board was on 17 June 1999.

programs experiencing funding pressures" and that transition discussions should focus "not only on the point of fleet/force introduction of the capabilities, but also on the intermediate (6.4/6.5 level) programs required to carry the necessary technologies forward."[169] This memo indicated that N091 would prepare a POM-02 Sponsor Program Proposal (SPP) for the S&T Corporate Boards review in March 2000 and that the POM-02 budget would reflect changes based on this new process.

The initial guidance for the preparation of investment plans for funding within POM-02 requested S&T investment priorities be submitted without fiscal constraints. The funding requested in this stage of the process exceeded OPNAV POM budget targets by a factor of three. In November 1999 a final prioritization of the FNC emphasis areas was released, and guidance on a proposed S&T technology investment program was provided[170]. The guidance indicated that DoN S&T Program would be flat-funded (negative real growth) after FY-02 and that the same funding controls would apply in the outyears. The guidance mentioned ASN(RD&A) interest in the S&T Program establishing deliverable goals and directed the IPTs to prepare an itemization of the capabilities they plan to deliver as well as a prioritization of other capabilities to be considered for an "above core" funding request. It was noted that the DoN S&T investment plans would need to address other high priority applied (but non-FNC) S&T efforts referred to as "fact-of-life" efforts. A review of all IPT proposals for the FY 2002 Core and Above Core funds was announced[171] by OPNAV N911 with the review board being chaired by N091B and composed of a single representative from CNO, CMC, ONR and ASN(RDA).

The Requirements and Acquisition communities were generally supportive of the new FNC process. As an example OPNAV Air Warfare (N88) and the Naval Air

[169] Director, T&E and RT, Memorandum for Science and Technology Corporate Board, *Future Naval Capabilities*, Ser N911T/9U542052, 5 October 1999

[170] CNO N091 Memorandum for Distribution, *Future Naval Capabilities Fiscal Guidance*, Ser N091/9Y53894, 23 November 1999

[171] N911 Memorandum, *Guidance for the Submission of Core and Above Core Programs for FY 2002*, 7 January 2000.

Systems Command released a joint memorandum expressing support and offering recommendations for improving the process.[172] The types of recommendations offered were:

- Coordination (deconfliction) between FNC programs be a formal step in the process.
- Specific written criteria be provided to the IPT for allocating funds to Core and Above Core for FNC demonstration programs.
- The process for funding "high priority applied but non-FNC efforts" be clearly delineated. The aviation community expressed concern over critical needs not included in any FNC program that were in danger of losing all funding and they wanted those programs to be funded out of these high-priority non-FNC program lines.
- A set of lessons learned operating procedures be documented from the S&T program building processes of four specific FNC IPTs.[173]
- A systematic approach to IPT conduct to ensure rigor in evaluation and prioritization.

While being supportive of the process the aviation community was concerned that certain critical components to their program were severely under funded, such as the Total Ownership Costs FNC, and requested the TOC allocation be increased to "accelerate the development of S&T solution to our most pressing fleet readiness problems." The aviation community was not the only ones offering recommendations on the FNC program content. At this time similar FNC reallocation requests were also being provided to the CNR by others, for example the submarine community[174], as well.

The S&T Program structure changes being implemented by the Navy would be significant and would involve the writing of R-2 funding documents and the generation of an entirely new set of S&T Program Element (PE) documents. As part of these changes ONR's S&T Leaders were provided guidance on aligning the FNC Process with higher-level (DoD) processes such as the DUSD(S&T) Defense Technology Objective

[172] CNO-NAVAIRSYSCOM Joint Memorandum, *Future Naval Capabilities Process*, Ser N88/0U660109, 29 February 2000.

[173] The aviation community feedback singled out the Time Critical Strike, Littoral ASW, Missile Defense and Warfighter Protection IPTs as being particularly notable.

[174] NAVSEASYSCOM Memorandum, Request for ONR Support of Future Submarine Science and Technology and Research and Development, Ser 08/00-02154, 25 February 2000.

(DTO) process[175]. The formal coupling of Navy S&T programs to OSD processes raises concern within DoN. The concerns raised are due to the additional constraints that such a coupling imposes on the use and execution of DoN resources. These additional constraints reduce the DoN's flexibility in managing the S&T account through the need to obtain DoD approval for later programmatic changes. The concern is that the added layer of management activity that such approvals require tends to slow down the innovation cycle. In a memorandum to the DUSD(S&T) ONR emphasized the DoN S&T program would likely mean that some existing programs might be terminated early and that some of these program might be contained within existing DTOs. A second point made was the new FNC Process would be "transition dependent" and that if a transition path is lost the S&T program would be "terminated or redirected, as will the corresponding DTO[176]." A greater awareness of the potential implications of the Navy's FNC Process continued to generate concern from the Office of the Director of Defense Research and Engineering (DDR&E) regarding the Navy's overall level of support of the DUSD(S&T) DTOs. A follow-up letter to CNR raised continued concerns over the proposed drop in Navy funding of DTOs due to the impact the Navy S&T program changes would have on the DoD DTO program since the Navy was a significant contributor of the cumulative Service and agency 6.2/6.3 funding of DTOs[177]. Navy funding levels of 29 percent were far lower than a previous DUSD guidance target of 50 percent. The level of DTO funding is an important issue for DDR&E because it gives credibility to the Defense S&T Reliance planning process and is used in support of the Government Performance and Results Act (GPRA) performance plan reporting and metrics that are reported within DoD, the Congress, White House, Industry, etc. The

[175] ONR ED-TD Memorandum, DTO-FNC Policy, 23 May 2000

[176] ONR ED-TD Memorandum, Harmonizing the DoN FNC and DUSD(S&T) DTO Processes, 01 June 2000.

[177] DDR&E Memorandum for CNR, The Importance of Defense Technology Objectives (DTOs), 16 August 2000.

concern was that Navy S&T Program changes could weaken the DoD joint Service and agency Reliance effort and cause DoD to fall short of GPRA targets.[178]

In August 2000 approved guidance and POA&M for the FNC Execution Offices were provided[179]. This guidance provided a brief overview of the overall S&T technology transition problem and presented the S&T Program changes, of which the FNC program is a component, as a way for the Navy to provide balance, integration and focus to resolve the transition problems. The Navy's S&T problem, as stated in this guidance memorandum, was:

> When resources decline S&T organization tend to divide what remains equally across existing programs. But S&T programs – especially maturing applied programs – require a critical mass of support if they are to transition. Without some concentration of resources to keep priority programs at critical mass, little or nor progress can be made. Furthermore, declining resources also tend to push organizations to pursue short-term goals at the expense of fundamental, long-range work – the principal focus of the ONR mission.

This guidance presented the Navy's strategy for the FNC Program and identified specific representatives for the FNC IPT Execution Offices. As outlined by this guidance document each of the (twelve) FNC IPTs would consist of four representatives, one for the DoN Requirements (also serves as Chair for the IPT), a second for S&T (ONR), a third for Acquisition (SYSCOM/PEO), and a forth from S&T Resources (N091). For each of the FNC IPTs a summary of the Objectives, prioritized Enabling Capabilities and designated representatives for the four Execution Office representatives was provided.

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[178] The Office of DUSD(S&T) would later release a DOD guidelines document (Technology Transition for Affordability, April 2001) to provide DoD S&T program managers with strategies for implementing best practices to achieve technology transition. This document mentions the need to have S&T be "more rapidly transitioned to an operational capability to compensate for constrained DOD budgets and to keep pace with commercial availability of advanced technologies." This guidelines document addresses technology transition issues, concepts and programs across all of the Defense Services and Agencies. The Navy's FNC program and the Chief Technology Officer were the two key Navy technology transition initiatives mentioned in this document. The Navy's TOC FNC was specifically mentioned separately as an important initiative, emphasizing the importance on system cost and affordability that DOD was placing on their technology initiatives.

[179] ONR Memorandum, POA&M and Guidance for Future Naval Capability Execution Offices, 8 August 2000.

From a February 1 FNC Status briefing the FNC program development was continuing the process leading to execution of more “business like” programs. The FNC Process approach consisted of developing business plans and securing transition agreements from the acquisition community. New naval warfighting capabilities would be developed through the support of a number of “spike” programs[180]. Clear exit criteria would be required and, introduced later in the process, the use of NASA technology readiness levels (TRLs) would be required as an attempt to standardize technology expectations. At this stage business plans and transition agreements were generally considered to be “weak.” It was determined that most transition plans lacked strong commitment from acquisition community.

There were three separate FNC groupings identified. Six of the FNCs had a focused customer group (Missile Defense, Time Critical Strike, Littoral ASW, Platform Protection, Autonomous Operations, and Organic Mine Countermeasures). There were three other FNCs which had widely varying customer groups within the Naval community (Decision Support Systems, Expeditionary Logistics, and Information Distribution). Finally there were three FNCs that were viewed as “trying to fit within the FNC Process” (Warfighter Protection, Total Ownership Cost, and Capable Manpower). This grouping, and the order within a group, seems to imply a high-level prioritization of the FNC IPTs.

Proposed structure changes were presented to the Navy’s S&T Corporate Board on 12 April 2001 with a follow-up briefing being held on 23 April 2001. Based on the approval of the Corporate Board FNC program structure changes were finalized and announced in late May 2001.[181] These changes formalized the addition of two entirely new FNCs (Electric Ship and Littoral Combat) as well as the combination of the Information Distribution and Decision Support System FNCs into a single FNC to be renamed the Knowledge Superiority and Assurance (KSA) FNC. These changes also

[180] The “spike” terminology indicated the level of investment would be significantly increased (over current DoN investment levels) for a narrow warfighting shortfall area in order to deliver new capability’s within that technical area. The narrow field of focus and high investment level defined the specific “spike.” The reference to spike investments was eventually dropped as the investments were simply referred to as the twelve individual FNCs.

[181] CNO Memorandum, *Future Naval Capabilities*, Ser N091/1U539112, 24 May 2001

formally changed the basic structure of the FNC IPT from that of four naval communities to five by adding a Fleet/Force representative to the IPT. Consistent with previous guidance the new IPTs were charged with the responsibility of determining their enabling capabilities. With these changes the list of FNC investment areas became:

- Autonomous Operations (AO)
- Capable Manpower (CM)
- Electric Warship and Combat Vehicles (EWCV)
- Knowledge Superiority and Assurance (KSA)
- Littoral Anti-Submarine Warfare (LASW)
- Littoral Combat and Power Projection (LCPP)
- Expeditionary Logistics (ExLog)
- Missile Defense (MD)
- Organic Mine Countermeasures (OMCM)
- Platform Protection (PP)
- Time Critical Strike (TCS)
- Total Ownership Cost (TOC)
- Warfighter Protection (WP)

A number of programmatic issues were under consideration at this time. The formation, as an example, of an "Overarching IPT" was now under consideration. The Overarching IPT concept was considered in the initial stages of the FNC Process but was discarded at that time as being unnecessary. This version of the Overarching IPT would have N7 as the Chair of an OPNAV "Overarching IPT" which would consist of a military 3-Star Oversight Panel. It was also being suggested that a Fleet/Force (F/F) member be introduced as a 5th chair of the IPT for each of the FNCs. It was recommended that CLF nominate membership as F/F coordinator. Another recommendation under consideration was for ONR to formalize the FNC Process and develop an integrated multi-year schedule with the S&T Resource Sponsor, OPNAV N911.

Regarding the establishment of a consistent metric for determining program technology maturity, DDR&E released guidance on the use of Technology Readiness

Levels (TRLs).[182] The TRL definitions, based on a NASA framework, were incorporated into the plans for defining the technical maturity level for FNC investment projects. The FNC exit criteria and the TRL would establish the technical maturity required by the acquisition community for transition. The project exit criteria and the TRLs negotiated between the S&T community and the acquisition program manager would be the basis for a 'contract for transition' used in the technology transition agreements. The most significant use of the NASA TRLs was their tie with the Exit Criteria as the defining metric in establishing technical maturity and a project's readiness for acquisition.

The business aspect of the FNC program remained an area of management focus. In November 2001 guidance was provided for the development of business plans required for each FNC Execution Office. The business plans were focused on documenting and negotiating the transition of the S&T spike program to an acquisition customer. The business plan[183] was regarded as the highest-level plan generated by an FNC and would provide a description of the work and exit criteria at the product level and would be supported by detailed plans[184] for the individual S&T products. As described by this guidance the purpose of the FNC business plans were:

- To provide both a common, product-focused management tool and a common, universally understood language across all the FNCs.
- To provide an internally consistent means by which the S&T senior leadership can monitor and evaluate the products being developed.
- To provide consistent, technically grounded data to defend worthy programs or to terminate programs that have not demonstrated effectiveness.
- To focus resources to ensure the critical mass needed to meet the exit criteria.

182 DDR&E Memorandum, Interim Guidance for Implementing Technology Readiness Levels, 5 July 2001

183 ONR Memorandum for Distribution, Future Naval Capability Business Planning, 9 November 2001

184 ONR Memorandum for Distribution, Future Naval Capability Detail Planning and Execution, 9 November 2001

- To provide an up-to-date document that keeps management and the execution team informed of the products and resources being applied to an FNC.

This business planning guidance provided a template to be used in the development of business plans as well as definitions on a variety of terms including enabling capability, exit criteria, return on investment (ROI), risk assessment/risk management, technologies, and transition.

By the start of 2002 a number of external events were having an impact on the FNC Process. Such factors as a new CNO and CMC, the release of the QDR results and SECDEF transformational directives were initiating a review of the FNC Process and transition products. Of particular importance to the FNC Process, because of its heavy emphasis on the need for firm and credible transitions to acquisition programs, was the cancellation or reduction in scope of some acquisition programs within DoN.[185] Such high level programmatic changes to acquisition program would potentially jeopardize a number of the FNC IPT project transitions. Program redirection as a fallout of the September 2001 terrorist attacks was a possibility as was program resource reductions as a result of the need to fund the war on terrorism. There was also a recent formulation of an OPNAV requirements "Technology Oversight Group" to coordinate the requirements planning among the various OPNAV codes as well as a completely new OPNAV requirements process called Mission Capability Packages (MCPs).

Severe DoN budget pressures lead to a series of reviews that looked at the FNC portion of the S&T program in greater, and more critical, detail. A summary of the major points from the May 2002 Technology Oversight Group (TOG) review team comments on the FNC program are[186]:

- The definition of what constitutes an FNC Transition has not been formally promulgated. Three separate types of possible transitions were discussed in limited detail.

185 For example the DD-21 and VTOL UAV programs.

186 CNO Memorandum, Ser N091A/2U539024, 7 May 2002.

- In general detailed budgets had not been prepared by the IPTs and were not available by the end of the review. Without this information the TOG review team could not assess the cost, schedule and performance plans for the various projects. It was also noted that a significant analysis of resource requirements had not been performed.
- Some work more properly aligned in 6.3 is planned for execution with 6.2 dollars. The (negative) impact of the FNC program on the 6.2 portion of the E&D program was evident in a comment made regarding the "awkward" funding profiles which resulted from projects having to use 6.2 dollars to complete work after the 6.3 resources were exhausted.
- Routine "taxes" had not been planned for execution of the projects. The observation was made that confusing and conflicting message had been sent to the IPTs concerning whether or not their execution plans should account for nearly 10 percent taxes assessed each year on R&D programs. The suggestion was that the FNCs should be planning for 10 percent of their resources to "end up in other areas" due to undistributed Congressional reductions, pricing adjustments, and unforeseen requirements.
- Significant FNC project funding was being allocated to demonstrations to be conducted in the outyears without, was the opinion, full justification.

These TOG reviews, coupled with the FNC program structure changes, were forcing a closer scrutiny of entire FNC programs in order to find the required resources to make the transitions occur as planned. This closer examination of the FNC programs started to raise questions regarding the underlying initial assumptions that all FNCs were created equal. This review, as an example, was very critical of the Capable Manpower FNC and the review team suggested a further review of this FNC would be needed to "show that duplication of work or research already conducted by industry and government is not occurring."[187] At the same time, however, neither of the two new FNCs (Littoral Combat and Electric Warship) was reviewed because their programs had not been solidified. Both, however, appeared to be viewed from an apparently more sympathetic vantage point by the review team noting that "neither FNC has been funded to the desired level." The results of the O-6 level FNC program review and

[187] The issue regarding the CM FNC revolved around fundamental differences of opinion regarding whether or not the projects being funded by the CM IPT were S&T in nature and/or being done at a sufficient level by industry or others. Although Manpower and Training were clearly articulated priorities of the CNO this FNC funding issue would surface on several occasions for the CM IPT.

recommended program reductions were released in mid-June 2002.[188] The TOG met later in the month to review earlier recommendations and requested the O-6 FNC review team to assess the FNC projects with respect to relevance to transformation as defined in Sea Power 21. The results of this assessment were released in July 2002.[189] After having examined the strength of the transition agreements, value to the warfighter, and alignment with the QDR/Navy Transformational Roadmap for the FNC spike projects the TOG identified 29 additional projects from six of the twelve IPTs for reductions[190]. The rationale provided for recommended reductions were that the programs targeted were not aligned to the QDR/Navy Transformation Roadmap, did not an adequate transition commitment and had a low (perceived) value to the warfighter[191]. Following reclama discussions the TOG Option 1 reductions to the FNCs were eventually restored and 8 percent of planned FY 2003 FNC funding was placed on administrative hold.[192]

One of the objectives of this period of reviews was an attempt to stabilize FNC program funding at new thresholds ($500 M or 30% TOA). Another objective was to formalize the OPNAV requirements process by instituting a more formal method to consider major program changes. A number of programmatic issues were being raised at this time among the stakeholder community. For example, there was concern that a formal method to initiate new projects into an FNC did not exist. Similarly, a formal process did not exist for the termination of FNC IPT projects or for adjusting the FNC IPT Enabling Capabilities across the FYDP. Other areas of concern included the possible need to rebalance the FNC portfolio to free-up resources for new OPNAV investment priorities, standing up a new EC to address the Navy's Counter-Terrorism/Force

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[188] CNO Memorandum, Final Results of O-6 Level Future Naval Capabilities (FNC) Review, Ser N091/2U539057, 17 June 2002.

[189] CNO Memorandum, Results of O-6 Level Review on Transformation in Future Naval Capabilities (FNC), Ser N091/2U539084, 19 July 2002.

[190] PowerPoint briefing, Navy FNC Program. Dynamic Management Processes Assuring Program Relevance, 12 Aug 02

[191] PowerPoint briefing, Navy FNC Program. A Key Part of Naval Transformation, 13 Aug 02

[192] ONR Memorandum, Update to Fiscal Year 2003 Department of the Navy Science and Technology Investment Guidance, Ser 08E1/169, 2 October 2002.

Protection concerns, address the structure of the DoN S&T FNC Process beyond FY 2007, as well as the appropriate OPNAV N7/N8 role regarding FNC program requirements definition.

By the March 2003 TOG meeting the FNC Process was looking at aligning with the CNOs Naval Power 21 Process. The IPT structure was back to a "four seat" arrangement due to the merging of the S&T Resource Sponsor executive secretary position (N091) with the S&T position and the (previous) addition of the Fleet/Force position. Overall requirements guidance was being coordinated by the TOG with representatives from N6/7, DASN(RDT&E), CFFC, CNR and MCCDC. Top-level guidance was approved by the Navy's S&T Corporate Board which consists of the VCNO, ASN(RDA), ACMC and CNR. A listing of some of the initiatives includes:[193]

- Budgets have been stabilized.
- Transition agreements remain vital to program success.
- There has been an alignment of IPTs with Naval Power 21.
- Decision to protect the CM and WP FNCs and align them with Sea Warrior.
- A "new start" process is being looked at. The IPTs update their business plans on a quarterly basis and have been encouraged to think about opportunities for new project starts within their existing ECs or anticipate the possibility for an introduction of some entirely new ECs. The goal is to gradually transition to a process for delivering capabilities beyond FY07. A staggered approach is desired in order to avoid having a completely new set of FNCs and/or ECs start in FY08.
- The EWCV FNC was considered "below critical mass" and restructured to become the "Advanced Electric Capabilities Systems FNC".
- Additional program flexibility, via possible TTA transition ratios, are being considered. There have been discussions regarding the implementation of an 80:20 ratio for TTAs. This ratio would require only 80 percent of IPTs funding needing to be tied to specific transitions, where TTAs would be required, thereby releasing the remaining 20 percent of IPT funding to be available for more innovative S&T efforts where a TTA would not be required.

193 PowerPoint briefing, *Future Naval Capabilities Review*, 13 March 2003.

The TOG Terms of Reference were released in May 2003.[194] The TOG objectives were to:

- Integrate and assess all FNCs; align resources and investment strategy to address the four Seapower 21 Naval Capabilities.
- Provide FNC investment guidance directly to the Chief of Naval Research/Director of Navy Test and Evaluation and Technology Requirements (N091).
- Review/Approve future FNC program changes (new starts, terminate existing FNCs and enabling capabilities within an FNC).
- Provide a summary of activities to the S&T Corporate Board as appropriate.

4. External Reviews

The FNC Program has undergone a number of management reviews and program assessments over the past couple of years. When the FNC program was first being established, for example, there was a review of the programs being funded by the Navy's Advanced Technology Demonstration (ATD) program to determine the potential applicability of ATD program to the new FNC Process. This purpose of this review was to evaluate the ATD program in terms of its "applicability to designated Future Naval Capabilities."[195]

As the FNC program was being established there were a variety of assessments conducted. There were monthly assessments of transition readiness and execution progress at the project level (cost, schedule, technical). There were periodic status meetings (some monthly, some quarterly) intended to resolve a number of miscellaneous programmatic issues being encountered. At the same time there were also a number of additional alignment assessments with other processes and initiatives such as the Quadrennial Defense Review (QDR), the new CNO's stated priorities, the OPNAV Mission Capability Packages (MCPs), the Command Capability Initiatives (CCIs), and ONR's National Naval Responsibilities (NNRs).

[194] ASN/ACMC/CNO Joint Memorandum, Technical Oversight Group (TOG) for Future Naval Capabilities (FNCs), 23 May 2003.

[195] CNR Memorandum, Department of the Navy Advanced Technology Development (6.3) Program Review, Ser 35/116, 1 June 1999.

An assessment of the FNC program was held in September 2000. The purpose of this review was to review the status of the FNC program portfolio "regarding prioritization of efforts, demonstration schedule, transition funding and any unintended consequences resulting from POM-02 funding decisions."[196] According to guidance documents OPNAV N091 staff would review the technical issues and comments provided and recommend programmatic adjustments.

Another program assessment was conducted at Johns Hopkins University Applied Physics Laboratory (JHU/APL) in late March 2001. Although several reviews of the FNC program had already occurred, the guidance for this review stated that this assessment was intended to support the PR-03 process and meet the VCNO requirement for an annual review of the S&T Program.[197] At this assessment review a number of items were raised and discussed:

- The creation of a Commercial Technology Transition Officer (CTTO) role. This position, a refocusing of the Chief Technology Officer duties, would use ASN 6.4 funding to assist in establishing transition paths. The stated thoughts were that the commercial sector has technology "on the shelf" that cannot be developed or fielded in a rapid manner due to low Return on Investments. The CTTOs access to, and use of, 6.4 resources would provide "bridge" funding in support of transitions.
- The creation of a Naval Technology Transition Officer (NTTO) was announced as well. The NTTO duties would be analogous to those of the CTTO regarding the search for a transition target for the capability being developed by the FNC programs.
- There was a desire to create two new, additional, FNCs: a Marine Corps FNC, Littoral Combat, and a Navy FNC, Electric Ship. There was a desire to keep the number of FNCs constant which would require some FNCs to be combined in order to make room for the two new FNCs. Two FNCs were identified as likely possible candidates for program consolidation; the Information Distribution FNC and the Decision Support Systems FNC.
- OPNAV N70 would be used to coordinate the overall OPNAV requirements input for the FNC program. It was noted there was a clear mismatch between naval missions and available S&T resources. The role

[196] CNO N091 Memorandum, *Future Naval Capabilities (FNC) Assessment*, Ser N091/0U539170, 9 August 2000.

[197] CNO N091 Memorandum, *Future Naval Capabilities (FNC) Assessment Guidance to Presenters*, Ser N911T10/1U539018, 07 March 2001.

of N70 would be to monitor all of the FNCs and recommend overarching adjustments to ensure the Navy's highest priority capabilities would get the necessary level of support.

- The issue of "taxes" was raised. Since the 11 December 2000 Program of Record was released the FNC were asked to provide input on an approximately 11% tax. The two new FNCs would likely be funded by a 2% tax across the board. There was also talk of another possible "tax" downstream due to possible future OSD cuts.
- There was discussion over the lack of acquisition community representation as well as discussion over the Fleet's voice not being heard by those inside the beltway.

An N091 assessment of the FNC program was conducted over a two day period at the Warfare Analysis Laboratory at Johns Hopkins University/Applied Physics Laboratory (JHU/APL) in January 2003. This assessment was the first to be presented to the newly established Technology Oversight Group (TOG) and was to present an overall FNC status of each of the FNC spike programs regarding prioritization, transition funding, demonstration schedule, staffing, etc., and to discuss problems and issues they may have encountered. During the introductory remarks the following major points were made regarding N091's assessment of technology transition issues:

- There would be close examination of the level and strength of commitment of POM04 resources identified by the FNCs.
- Transition Agreements were discussed. These will be required for all projects to ensure funding continuity. Programs without signed transition agreements are subject to becoming bill-payers for other initiatives.

Because of continuing and immediate demands being placed on the DoN S&T account as a result of budget cuts being taken across the board in support of Operation Enduring Freedom, a Technology Working Group (TOG) meeting was held in March 2002 and a follow-up TOG review of the FNC projects was held on 6 May 2002. This review team conducted an assessment of the FNC projects based on value to the warfighter and the strength of the transition. The focus of the review team was on those projects that were identified as having low value to the warfighter and low strength of

transition to acquisition. With some exceptions most projects outside of one standard deviation below the mean were recommended for removal.[198] A reclamation meeting was scheduled for mid May 2002 where affected IPTs could make their case for the restoration of funding reductions. The guidance memoranda stated that IPTs could "propose alternative reductions that result in the same funding profile" since funding discussions would be on a "net zero sum basis."

a. Red Teaming Review

To help ensure the funded IPT enabling capability investment areas were adequately understood and would be leveraged by the Navy properly the CNO directed the Navy Warfare Development Command (NWDC) initiate an independent "Red Teaming" process to provide an independent assessment, and investment guidance, for future rounds of the FNC Process. Specifically the Red Teaming process was attempting to develop recommendations in time to affect any FNCs which might be selected for the PR-03 budget cycle[199]. This Red Teaming of the FNCs would evaluate candidate FNCs against potential future threats and disruptive technologies. The Red Teaming process, to involve wargaming exercises and quantitative analysis, was implemented to attempt to answer questions regarding the utility and technical assumptions of the various technology options. Red Teaming personnel would include, at a minimum, personnel from NWDC and the Office of Naval Intelligence (ONI). Objectives of the Red Teaming process would be to develop a comprehensive POA&M consistent with the next round of FNC to be selected (PR-03) and to develop Measures of Effectiveness (MOEs) for the FNC Process and its content. Some of the MOEs to be considered were[200]:

- The extent to which the FNC Process encourages discovery and tolerates technology push and pull.
- The extent to which the FNCs are future-going, vice toward legacy concepts.
- Whether the FNC Process is responsive to the Capstone Concept for the Navy After Next.

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[198] CNO Memorandum for Technology Oversight Group, *Results of O-6 Level Future Naval Capabilities Review*, Ser N091A/2U539024, 7 May 2002.

[199] CNO Memorandum, *Red Teaming of Future Naval Capabilities*, Ser N00/0U500042, 22 May 2000

[200] NWC Memorandum, *Red Teaming of Future Naval Capabilities*, Ser 00/4539, 06 June 2000

- Range of Navy tasks addressed.
- Whether the FNCs have implementation paths vice being “slaved to legacy acquisition processes and existing programs”.
- Does the FNC Process develop key enablers, specifically for the full range of naval operations in the littoral.

b. Inspector General Report

The DoD Office of the Inspector General (IG) conducted an audit of the Navy’s effectiveness in transitioning advanced technology products to military applications. The IG team audited the Navy’s Advanced Technology Program, including the FNC Process, and released a report sharply critical of the Navy’s efforts in February 2003.[201] The report recognized the Navy created a new structure to manage its science and technology efforts to facilitate the transition of technology, but concluded that improvements on the coordination of technology transition activities were still needed. A summary of the findings of the audit include:

- All of the working level IPTs reviewed lacked charters establishing roles and responsibilities.
- S&T project recipients (customers) were not always included in the working-level IPTs. There was also a reported lack of agreement on technology readiness levels and exit criteria as well as limited documentation regarding IPT issues and actions.
- None of the (five) acquisition recipients had identified funding for those technologies scheduled to transition in FY 2002 and 2003.

In this report the IG observed that Congress and DoD officials had previously voiced concern that technology had not transitioned to the warfighter quickly enough. In order to maximize the benefit of the S&T program to the warfighter the VCNO instituted the FNC Process in FY 1998 to focus the science and technology investment on achieving capabilities for the naval forces. The new technology transition process shifted the DoN S&T emphasis from conducting basic research and development on long-term, high-risk technologies to developing more focused products that would be demonstrated, using pre-established exit criteria, within 7 years. The IG audit

[201] DODIG Report, *Navy Transition of Advanced Technology Programs to Military Applications (D-2003-053)*, 4 February 2003.

conclusions were, essentially, that a number of the ONR processes (management control, technology transition, performance appraisal, etc.) were not achieving the results desired effectively.

c. NRAC Report

The Naval Research Advisory Committee (NRAC) released a report on life cycle technology insertion that mentioned the FNC Process.[202] The NRAC panel looked at a variety of technology transition issues and, regarding the FNC Process, reported that:

> The panel found that the FNC process for exploiting naval S&T is not currently working as planned. The primary issues with the FNC Process relate to a lack of proper planning, lack of review, lack of involvement by integrators and end-users, and a lack of critical mass in terms of funding.

5. Mapping Products to Requirements

The original twelve FNC S&T investment areas were established by OPNAV N091 staff from inputs received as a result of a data call (Nov98). Although N091 maintained the original OPNAV requirements it was decided not to provide the FNC IPTs with the requirements. It was decided that it would be more useful to allow each FNC IPT to start out with a clean sheet of paper and determine its own requirements and operational focus. As a result, none of the original requirements were deliberately addressed by any of the FNC IPTs. As time went on and external exposure of the S&T investment areas became more pronounced there was a need to assess the relevancy of the FNC products to a variety of externally generated naval needs and requirements. FNC products were mapped to OPNAV Mission Capability Packages (MCPs),[203] Command Capability Issues,[204] DoD Operational goals,[205] National Naval Responsibilities,[206] to the QDR,[207] as well as to the CNO's Sea Power 21 thrust area pillars (Sea Strike, Sea Shield, Sea Basing and FORCEnet).

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[202] Naval Research Advisory Committee, *Life Cycle Technology Insertion*, NRAC 02-2, July 2002.

[203] Excel spreadsheet, *FNC_Product_MCP_Assessment*, 9 Jan 02

[204] Excel spreadsheet, *FNCs mapped to 2002 CCIs*, 14 Feb 02

[205] Excel spreadsheet, *FNCs mapped to DoD Operational Goals*, 19 Jan 02

[206] Excel spreadsheet, *FNCs mapped to National Naval Responsibilities*, 17 Jan 02

6. Communications

OPNAV N091 staff, serving each IPT in an Executive Secretary role, would serve as the primary cross-FNC means of communications. In January 2001 the establishment of a DoN S&T Website was announced by ONR.[208] The DoN S&T website was to be secure and would facilitate unclassified information flow and promote cross-community collaboration. The website would support the entire S&T Program and would provide a convenient source of information for the FNC Process. The website would provide the Navy and Marine Corps community a number of services including discussion groups, a calendar, document exchange, and postings in specific areas of interest. Due to the sensitive nature of military information only members of the government S&T community would receive access.

7. Stakeholder and Participant Feedback

To capture an assessment of the FNC Process from the perspective of S&T stakeholders and participants in the FNC technology transition process, a series of personal interviews of stakeholder community personnel was held and an FNC Process feedback survey was circulated among the stakeholder communities via electronic mail. For a more informed response attempts were made to contact individuals who were actively involved in the FNC Process. In many cases this was difficult due to the rotational nature of the OPNAV military positions as well as due to numerous personnel who retired or left government service. NRSAs were asked to provide fleet input on the survey in their Science Advisor capacity. The interviews and survey responses were for non-attribution and helped establish a baseline for how the S&T FNC business process was being viewed across the S&T stakeholder community. The unedited survey responses are included as Appendix A of this thesis.

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[207] Excel spreadsheet, *QDR_FNC_Mapping-PreTOG*, 12 Mar 02

[208] ONR Memorandum, *Naval Science and Technology Website*, Ser 00ST/4155, 08 January 2001.

D. SUMMARY

The Future Naval Capabilities (FNC) process was initiated in FY 1998 to focus the DoN S&T investment on the achievement of future capabilities for Naval forces. The FNC Process was designed to align and partner the requirements, acquisition, and S&T communities to deliver and transition high-priority naval capabilities to the warfighter over the FYDP. The Vice Chief of Naval Operations, the Assistant Commandant of the Marine Corps, and the Assistant Secretary of the Navy for Research, Development, and Acquisition approved the FNC Process and the specific S&T investment areas that concentrated one-half of the Navy's S&T Program resources on achieving the selected high priority naval capabilities in a greatly accelerated manner.

1. Integrated Product Teams

The core component of the FNC Process is a consensus-based decision-making IPT made up of Flag Officer or Senior Executive Service level personnel from each of the requirements, acquisition, and S&T communities. The IPT approves the naval capability investment areas, prioritizes the required enabling capabilities and approves the selection of S&T products to deliver those capabilities to an acquisition program within the FYDP. Each FNC IPT represents the entire DoN community for their investment area and the IPT ensures investment decisions are done in a consensus-based manner. Personnel on the various IPTs would be established by the following authority:

- Vice CNO / Asst CMC assigns Requirements member
- ASN(RDA) office assigns Transition responsibility
- CNR assigns S&T Execution Leader
- N091 (S&T Resource Sponsor) assigns the Executive Secretary/Resource Rep
- Fleet/Forces Command assigns Fleet/Forces Representative (added later)

2. Program Structure

There is no ranking or prioritization among FNCs as each FNC is considered to be of equal importance to the DoN. An FNC is a high level area of naval research focus that

is divided into a number of prioritized Enabling Capabilities (EC's). These EC's are considered essential for the delivery of the fundamental (future) naval capability. Each EC is made up of a number of S&T "spike" investment areas which deliver a specific product(s). The EC spike areas are not prioritized. Each FNC spike will provide significant technology option(s) and operating concepts for the required DoN future naval capability. Each S&T spike investment area will have a significant budget and will establish definite program milestones and technical objectives. Each spike program will establish concrete deliverables and culminate in well-defined demonstrations and transition the naval capability to a DoN acquisition program or industry.

3. Business Processes

There has been a direct effort to use best business practices in the execution of the S&T FNC program. As an example, each of the FNC IPTs were directed to develop business plans which would detail the S&T portfolio investment decisions being made by the individual FNC IPTs. These business plans would document the 'business case' for the overall S&T investments and document the exit criteria being used. These business plans would describe the technical maturity level of the technology through Technology Readiness Levels (TRLs), contain high-level execution information, and identify a specific acquisition community that would transition the demonstrated capability. The acquisition community commitment to transition would be documented by Technology Transition Agreements (TTAs).

4. Technology Transition

The primary goal of the FNC Program is to ensure that DoN S&T programs develop and transition mature technologies in support of specific high-priority naval capabilities and deliver these new capabilities to acquisition programs for operational use. Technology Transition Agreements (TTA), negotiated between an ONR S&T program manager and an SYSCOM/PEO acquisition program manager, are used to document the transition plans. In the negotiation of a TTA there are a number of key components that must be agreed upon. These include exit criteria, completion/transition year, level of

maturity/risk (Technology Readiness Level), description of product and a demonstration of TRL. Although a core component of the transition process, a precise definition of what constitutes a transition has been very difficult to quantify. Generally the identification of an acquisition 6.4 PE in a TTA has been the fundamental metric for transition intent. A FNC Review team reviewing the S&T portfolio for the TOG commented that "the definition of what constitutes an FNC Transition has not been formally promulgated[209]" and described three different types of transitions (hardware installation, software development and a process/procedure development).

Using an acquisition program PE (BA4 and up) can cause problems if the targeted transition platform experiences problems of its own (as was the case with the DD-21 program). "Any cancellation of an acquisition program for which an FNC project was designed to transition will cause termination of the FNC project as well[210]."

[209] Enclosure 1, Item #1. *Results of O-6 Level Future Naval Capabilities Review,* OPNAV (N091) memo 3900 Ser N091A/2U539024 dated 7 May 02.

[210] Enclosure 1, Item #9. *Results of O-6 Level Future Naval Capabilities Review,* OPNAV (N091) memo 3900 Ser N091A/2U539024 dated 7 May 02.

V. DATA COLLECTION AND ANALYSIS

A. INTRODUCTION

The literature review presented in Chapter II provides background information on DoD business process guidance as well as more general commercial business processes, metrics and models. An overview of the Navy's S&T Program was presented in Chapter III. Detailed information of the implementation and execution of the FNC program, a major subcomponent of the Navy's S&T Program, was then presented in detail in Chapter IV. This chapter builds on the understanding of the FNC program within the framework of the DoN Program and analyzes data from the FNC Process in an attempt to determine if the FNC Process has in fact allowed the DoN to operate in a more businesslike manner. Evidence of an achieved ability to operate in a more businesslike manner would be in line with DoD guidance.

Data were collected from a variety of independent sources in an attempt to capture correlating indicators. Interviews were conducted with a variety of personnel throughout the stakeholder communities. The interviews sought information on DoN business processes as well as the Navy's various technology transition processes and any issues encountered when attempting to transition new technologies to acquisition programs. Some of the interviews were formal (questions with responses recorded and later transcribed) while others were informal discussions that were not recorded. In one case a formal interview was not captured due to a recorder malfunction. Interviewees consisted of active duty Flag Officers, current/retired civilian Senior Executive Service members from ONR and the SYSCOMs, past/present FNC IPT members, a former ASN(RDA), a military industry sector Corporate Vice President (for a high-level, non-government perspective on the technology transition problem) and several personnel supporting DoN S&T processes in various capacities.

An electronic survey was circulated to persons who were knowledgeable of and actively supported the FNC Process in some capacity. The objective of the survey was to obtain credible feedback on the FNC Process from persons who were intimately involved in the process and therefore knowledgeable of its goals, objectives and processes.

B. GENERAL PRINCIPLES

This section compares business operating principles to the processes involved in the implementation of the DoN FNC Technology Transition Process. The analysis draws upon data collected during the literature survey of previous chapters as well as insights obtained from formal personnel interviews and more general informal discussions.

1. Operating Guidance

High-level guidance within the DoD has been very consistent over the years and appears to be in line with reasonable business practices: make the government agencies more efficient and lower the costs of doing business for the taxpayer. The focus of these initiatives has consistently to reduce costs. Instances can be found where guidance from various agencies within the government has been found to be conflicting but this conflict appears to stem from the different (and sometimes conflicting) missions, objectives and priorities of the various agencies involved. The conflicts are not resolved because of the bureaucratic infrastructure that has evolved over time. One example which relates to the DoN S&T account is the 3% growth guidance from OSD which appears to be in conflict with budgetary priorities and actions taken at the DoN level.

2. Defense Strategy.

OSD emphasis has clearly been on developing joint capabilities and in support of joint operations and experimentation. This joint warfighting emphasis is completely in line with guidance that emphasizes a business approach to operations in order to reduce costs. In this regard the push for greater jointness among the Services and Agencies is seen as a means to help DoD achieve greater cost reductions.

At the current time, however, there is not an overall Naval S&T strategy which has been articulated and integrates DoN objectives, priorities, and roles for planning joint capabilities development. Recent changes to the DoN S&T Program are an attempt to establish such a strategy by providing a balance between the long-term investments (the D&I half of the S&T Program) and short-term warfighting priorities (the E&D half of the S&T Program).

In accordance with OSD emphasis the DoN has pursued a "capabilities-based process," the Future Naval Capability process, to identify and prioritize naval needs, develop solutions, and deliver these new capabilities to the operational warfighter. Implementation problems have arisen, however, as a result of guidance that appears to provide confusing or conflicting investment priorities and severely constrains the program, fiscally.

The Services have historically been responsible to define their own needs, develop their own technical alternatives, and select and resource their own desired solutions. Within DoD there is concern that the Navy will not actively pursue new innovative or joint programs. There is some evidence of such a reluctance found in the Navy's lack of support for the ACTD program as well as the DoN's resistance to growing their S&T account to 3% of Navy TOA. Such actions undermine the DoD emphasis for realizing cost savings through multi-service program efficiencies. Improving interoperability among the Services continues to be a high priority emphasis for OSD which will require greater collaboration and program integration at all levels.

3. Business Principles and Environment

All interviewees expressed some degree of skepticism regarding the utility of applying business principles and using business models within the DoN S&T technology transition processes and framework. Most persons interviewed acknowledged they could see parallels between business processes and the OSD, DoD, and DoN directives over the years but felt the government and commercial sectors were too different to be able to make useful comparisons. Some thought the idea was absurd and one person, at least, thought the whole notion (the DoN trying to operate like a business) was "pure folly." A more typical response provided during the personal interviews, when asked for thoughts on the government trying to operate more like a business one SES-level interviewee commented, "I really don't know what that means."

a. The Profit Motive

Businesses are driven by profit and new growth in business. One simple example of such fundamental corporate objectives can be found in a passage by the Boeing Company printed in a short corporate history. This small volume, which recounts the early years of the Boeing Aircraft Company, notes that even though the Boeing Airplane Company survived with contracts from the U.S. Army, and others, additional growth was needed:

> It was clear, however, that to prosper, the company needed to build, mass produce, and sell aircraft of its own design.[211]

At the S&T level, within the DoN, the same profit motives of the corporate sector do not seem to apply. Where businesses strive to increase profits by keeping their costs down the emphasis within the government is on how fast it will be possible to get the money out the door and how fast is it spent—"obligations" and "expenditures." The government starts out with a budget and tries to spend exactly that amount of money over the course of the year with no residual funding left over. Industry tries to maximize their profits by increasing revenues while holding their expenses to a minimum. The two operating principles represent two very different extremes. As a mater of fact, because of Navy Comptroller actions, there are real disincentives when attempting to operate more efficiently. Because of the way the finances are managed there no mechanisms that would allow the Navy to reprogram savings earned from one program to other uses. As mentioned in an interview:

> Any money that is taken away from you this year, you don't get back. And it has an effect on you next year because if you're only growing at inflation there's that much less you're allowed to grow.

There are two points of note here. The first point is the disincentive caused by the Navy Comptroller taking any 'savings' earned through operating efficiencies. Such an approach immediately discourages innovative approaches to achieving increased operating efficiencies because any efficiency realized would actually work to decrease future revenues rather than increase them. The impact of this

[211] The Boeing Company (1998), A Brief History of the Boeing Company, p. 7.

fundamental approach to conducting business operations is widespread and severe. For example, some of the stove-piping claims and lack of program integration might be viewed as a natural result of such an approach to business operations. The second is the reference to growth at the inflation rate which, essentially, implies no real growth at all. No company could be successful with growth rates locked to the inflation rate.

b. The Customer

For any business the customer is the source of revenue and, as such, is the primary focus of business operations. In marketing terms, for successful companies, the customer is the target of a well planned, focused, marketing strategy. The four controllable variables of the "marketing mix" (product, price, promotion and place) are all focused upon satisfying the wants, needs and desires of the customer. When analyzed, the data collected from the responses to questions in the participant survey and personnel interviews indicate that a clear identification of the customer for the FNC Process was anything but obvious for those actually involved in the technology transition process. This confusion was due in large part to the discontinuities caused by having separate acquisition and financial resource systems used by the government. The confusion, however, is central to the problem studied within this thesis: an examination of business principles on the implementation of the FNC technology transition process. From a business perspective, if the identification of the customer is in doubt the ability to effectively focus those business activities required of the marketing mix is greatly diminished. The expected net result from such a business venture would reasonably be ambiguous results, wasted resources and frustration for all parties involved. FNC Process stakeholder feedback, as documented by comments made in the FNC Technology Transition Survey, appear to provide strong support for such an assessment.

c. Investment Indicators

In contrast to the commercial business sector, few useful metrics were found to guide DoN S&T investment decisions. The consequence of this lack of information is a widespread lack of awareness and appreciation of the need, utility and return on FNC investments being made by the IPT structure. Such a lack of awareness was indeed found by the assessments of the IPT provided by stakeholder participants who

completed and returned the FNC technology transition survey and, additionally, by many who were interviewed for this thesis.

There have been numerous volume of literature devoted to "resource allocation" concerns (where to invest limited resources) but very little was found objectively quantifying the payback, or return on investment, for S&T investments already made.

Many of the most common business environment performance metrics and "state of health" market indicators surveyed as a part of the literature search for this thesis were found to have no direct government investment comparison. The lack of useful metrics and performance indicators, however, does not mean that DoN S&T investment decisions are not subject to similar market forces. What it does mean is that absent useful metrics to guide the investment decisions the decisions are being made with less confidence and with considerably more risk. Investment decisions are being made using the information that is available.

> Investors have a pesky tendency to discount into the *present* value of a company's stock price whatever rate of growth they *foresee* the company achieving.[212]

This principle is one possible rationale for the observed decline in the investment of the DoN S&T account over the last forty years. The decline in the DoN S&T account is an indicator of a fundamental business investment problem for the DoN S&T account–there are no good performance indicators for S&T readily available. Within the business environment there are a host of such indicators which are used to make investment decisions.

> A company must deliver the rate of growth that the market is projecting just to keep its stock price from falling. It must *exceed* the consensus forecast rate of growth in order to boost its share price.[213]

The negative implications caused by the lack of such fundamental investment decisions tools are accented when one expects investment activity that does not materialize. For example, the restructuring of the DoN S&T account combined with

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212 Christensen, C. M. and Raynor, M. E. (2003). p 4. The emphasis is in the original text.

213 Ibid, p 4. The emphasis is in the original.

the increased budgets as a result of the terrorist attacks of 2001 caused some within the DoN to anticipate an increase in the Navy's S&T account, which did not occur. (The comparison of AF, Army and DARPA accounts would be useful.)

d. Oversight

Unless they were found to have made serious mistakes businesses have been allowed wide latitude in running their operations without undue outside oversight.[214] The same is not true within the government where there are checks and balances in place which are designed to prevent an accumulation of power. Although originally credited to the Boeing Company as they developed the 777 aircraft, the IPT concept is one not commonly found within the corporate sector (at least in the manner implemented by the FNC's). Based on the need to reach consensus agreements the FNCs IPT decision making structure is much more in accordance with House and Senate committee and staff dynamics and operations. Both arrangements are very similar; both reach agreements based on consensus and both organizational structures depend on significant support from staff to provide the decision maker with the information required to reach a decision. In both cases the quality of the staff is critical to the effectiveness of the organization.[215]

One of the persons interviewed for this thesis suggested there are some clear differences in how the two sectors (commercial and government) are allowed to operate. This person's observation was:

> We don't have the flexibility that a business does – to quickly change directions. We can't even buy things when we want to buy them! We're so constrained by the laws of the appropriation. Businesses don't have Program Element numbers. If the President of a business wants to take \$10M out of salaries, \$50M out of salaries, whatever, and put it into his Research pot, he does it. Or if he wants to take it out of Research and says "I really need more people," he does. Boom. We can't do that. If you want to think of the Admiral as the President of a company, we can do it but within tight limits and with LOTS of oversight.

[214] This is not necessarily true in some social areas (for example, health and environmental protection) where regulation has been tight since damage to citizens and the environment can be severe and permanent. Also, the recent corporate financial scandals, such as ENRON, are clearly leading to an increase in outside oversight and will change the environment for the commercial sector as well.

[215] Baker (2001), p. 98.

Throughout the implementation of the FNC Process the IPTs have periodically received additional guidance that reduced their resources and forced them to make capability tradeoffs in order to comply with fiscal constraints. Responses indicate that IPT investment decisions are made without serious joint IPT or Service consideration.

Attempts to refocus the FNC investments over the past few years have been mixed. Several changes to the FNC Program were made; an Electric Warships and Combat Vehicles FNC was added, a Marine Corps Littoral Combat & Power Projection FNC was added, and the Information Distribution FNC was combined with the Decision Support System FNC to create the Knowledge Superiority and Assurance FNC. Other intended actions, such as the termination of an entire FNC (Capable Manpower) were overturned during high-level program reviews. As such the process is viewed as fairly inefficient and the various stakeholder communities have little incentive to fund joint programs unless directed by Congress.

OPNAV is not adequately engaged in the IPT process and, because of higher priority budgetary issues, spends an extraordinary amount of time on OPNAV resource issues rather than on defining the desired warfighter capabilities and establishing the requirements for the S&T investment programs. Their focus is on how their resources are currently being spent rather than on planning new future capabilities in support of an overall DoN strategy. This emphasis forces OPNAV representatives to focus on immediate problems at the end of the process, rather than being proactively involved earlier in the planning process.

In many cases OSD programming guidance (i.e., 3% growth in S&T account) and emphasis (i.e., joint programs and ACTDs) is in direct conflict with Navy priorities. In the case of ACTDs, the emphasis on "jointness" is forced into the program late in the process and requires participation in a number of time-consuming program reviews.

4. Personnel

Businesses succeed or fail based on their selection of high quality personnel. The direct linkage between a successful organization and the personnel it utilizes was a recurring theme uncovered in the literature search, personal interviews, and survey responses. This observation is nothing new and was emphasized in a July 1945 Report to the President by Vannevar Bush, then Director of the Office of Scientific Research and Development, "The most important single factor in scientific and technical work is the quality of the personnel employed.[216]"

Businesses typically select a powerful leadership, provide them with authority and compensate them accordingly. This approach to management allows the persons involved to make decisions quickly which allows them to be more responsive to company needs. The management approach taken by businesses is thus in stark contrast to that of typical government management operations, and FNC management operations in particular, where decisions are made at a slower pace and are deliberately reached at based on multiple-organization consensus.

5. Use of Business Models

There is a wealth of literature that supports the need for and documents the successful use of appropriate business models across the commercial sector. Businesses aren't in business for very long without such models. In fact developing an appropriate business model may become a central issue for the FNC Process since

> … technology by itself has no inherent value; that value only arises when it is commercialized through a business model. As with [other technologies] the same technology commercialized through two different business models will yield two different economic outcomes.
>
> To create value from a technology, companies must create a business model for it, or else allow someone else's business model to govern the value realizable from the innovation.[217]

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[216] Bush, Vannevar (1945). Science: The Endless Frontier. USGPO, Washington DC. Pg 15

[217] Chesbrough (2003), p. 156.

Within the DoN S&T Program there is no known business model for the FNC Technology Transition Process. Although an exhaustive search was not attempted, there were no formal business models found for any of the major programs within the DoN S&T Program. There were instructions, guidelines and process diagrams found for a number of projects but nothing that appeared to document and model the expected parameters of business operations, as would be the case for a business model.

For the FNC Process, strides were taken to operate in a business like manner through such things as written business plans and transition agreements. Both of these documents were targeting the acquisition community and addressed such issues as technology readiness levels and delivery schedules.

Another planning tool found in use was technology roadmaps. A roadmap in this context is somewhat analogous to a business model in that the roadmap identifies paths through which the technology can be inserted into an acquisition program. The technology provides the "value" to the targeted acquisition program. There is one thing that a roadmap does not take into consideration that is critical – a detailed discussion of resources needed to achieve the objectives of that roadmap – nor is there a general discussion on how the technology will pay for itself once it has been "purchased." In all cases the roadmaps did not address resourcing requirements. Unless the roadmap was specific to a current acquisition program it was generally assumed that 100% S&T funding would be required to fund the technology development effort throughout its development cycle and eventual transition to some undefined future program.

C. INTERVIEW FEEDBACK

One OPNAV representative, when asked if their management was happy with the FNC Process, responded:

> That's a hard thing to address because of all of the turnover. Our current Admiral is too new to directly say "Yes, it's great" or "No, it's not." He's too new at working it and is still trying to decide. And he needs evidence to see that we're getting somewhere.

When asked what it is that OPNAV wants out of the FNC Process the response was crisp, clear and to the point, "He'd like to see products that transition to the fleet from the FNCs within a reasonable amount of time." This participant went on to explain:

> He's pretty adamant that we don't need to be spending hundreds of millions of dollars on things that wind up going nowhere – and we don't get an output from them. The bottom line is he'd like to see an output. That the money's being spent and we're getting something out of it.

This view of the FNC Process is consistent with the documentation establishing the process as well as on the emphasis on transition and delivering product to the warfighter in a more rapid manner. This comment also conveys the distinct impression that DoN S&T resources may have been wasted in the past and that there is little to show for all of the S&T investments of the past. Whether or not this impression is supported by fact becomes beside the point if this impression is widespread. This impression, raised by an OPNAV representative, points to a recurring and continuing problem for S&T – an inability to articulate tangible benefits that have been delivered to the fleet as a result of past S&T investments. Whether true or not, many representatives outside of the S&T community simply do not "believe" that much has been delivered. The S&T community does itself a disservice by not being able to clearly trace past investments to tangible products and new warfighting capabilities. In a sharp contrast to standard practices of the commercial sector the DoN S&T community has, in the past anyway, invested very little time and effort into marketing their successes and capabilities. The existing lack of awareness of the benefits of the S&T programs is a natural result of this disconnect from the consumer and customer of those products previously developed.

Another interviewee, a PMA Program Officer, expressed an opinion that some of the current S&T initiatives are probably futile efforts in trying to change the way S&T does its business:

> ONR is not an Acquisition Command so if they've developed a 'business model' that allows them to 'buy' technology and deliver it to the fleet, it is out of place. And they will fail. And they should expect to fail miserably. I think they're seeing that about now. They don't have the right people,

> they don't have the right background and they don't have the desire. If they really want to get their technology out of the building they should try to work with us more.

Having the right people to do the job (as well as making sure the wrong people are not involved), as alluded to in this remark, is a common theme found over and over again within the numerous documents researched for the literature survey chapter of this thesis, from personnel interview remarks and in the participant survey responses themselves. Ultimately it's all about the people.

When asked about the FNC Process's ability so far to support and transition specific programs out of S&T one interviewee, an OPNAV science advisor, commented:

> In the time that I've been here I have seen cuts by ONR where they've cut some programs completely out and others have been left and I am not real positive about what has been transitioned, about how many programs have actually transitioned. We get asked all the time and we just don't know. No one seems to know, not even ONR, and they're their programs.

This comment makes it clear that the question of transition, central to the FNC Process, remains unanswered even by those deeply involved in the process. Here an OPNAV representative, the source of the financial resources which support the FNC Process as well as the source of the capability requirements that the IPT programs are intended to respond to, indicates they do not have a firm grasp on what products and capabilities the FNC Program is delivering to the Navy. Furthermore, this comment indicates that the OPNAV representatives do not believe the ONR representatives have a firm grasp on this fundamental metric either. This observation seemed odd and when questioned about the level of engagement between OPNAV Requirements Officers (ROs) and ONR representatives this person commented there has not been a lot of interaction observed and that, "I think there is a need for a more cooperative effort between ONR and OPNAV. It appears that that's being attempted but its not working." Clearly, portions of these two communities are not working together as closely as they could.

When questioned about obstacles that prevent the Navy from transitioning technology concepts into acquisition programs more rapidly one of the interviewees, a Flag Officer PEO, remarked:

> I think there's several. One, I think we struggle with, is the identification of what the requirement is. And I use that word "requirement" very carefully because we're talking more about providing capabilities. I believe in the past we have relied too much on identifying the solution too early and therefore when you bring the widget to the table and it doesn't meet that specific, and sometimes narrowly defined, requirement then we do not have the support of the warfighter or the resource sponsor in carrying that out. One is an identification of the right capability we are trying to deliver. The second piece is often we do not involve a wide enough group in the early decision making of bring technology in. What I mean by that is that you've got to bring in, in my view, the warfighter, the program manager, and the industry technology folks, all in and agree where you want to go. And you've got to be willing to accept failure in the viewpoint that if that particular widget technology approach doesn't work then you have a back-up plan you can bring in. In our case sometimes we take something like an ACTD, which has a wonderful selling point in a particular time and space, and we'll go out and see what are some of its limitations and what its capabilities are and yet we have not put together a plan to transition it. You know, what if it is successful? You have to do that with the funding -- the resources -- and we tend not to be very open in that viewpoint. So, in summary, I would say that the obstacles are we identify the requirement too narrowly in some cases. Secondly, we don't have a back-up plan when it fails and don't have an option to go somewhere else. And thirdly, we are a little reluctant to actually put the resource stream in place early enough so that the impetus to succeed is there today.

This response, from a Flag Officer Acquisition PEO, provides important insight into a number of key technology transition obstacles being experienced today. The first problem mentioned was that, from an Acquisition PEO perspective, the DoN continues to struggle in identifying specific naval warfighting requirements, now being expressed as needed naval capabilities. The shifting emphasis from requirements to capabilities is fully consistent with OSD, DoD and DoN emphasis on capabilities and the efforts to articulate a "capabilities-based" set of requirements. The fact that an Acquisition PEO, the organization that does the system engineering and buys the weapons systems used throughout the DoN, mentions a lack of a clear set of (capability-based) requirements as the first obstacle to fielding new technologies should be an immediate "red flag" for any S&T process that attempts to influence such systems.

The second obstacle mentioned was a lack of buy-in from a broad constituency ("we do not involve a wide enough group in the early decision making") in the early phases of program development. The FNC's IPT approach is an attempt to mitigate this problem by bringing appropriate community leaders together to discuss these programs at an earlier stage of development. In some regards the IPT approach has helped but the effectiveness of the IPT approach as currently implemented is questionable.

The third critical set of obstacles mentioned by this interviewee was the fact that there has been very little effort made in actually planning for a successful technology transition. Not only are there no transition plans, there are also no back-up plans if the technology were to fail and the PEO's are "a little reluctant to actually put the resource stream in place early enough so that the impetus to succeed is there." From an acquisition perspective (risk-adverse), the fact that there is "no back-up plan" is a metric which emphasizes the lack of serious intention to transition the technology if it were to be successful.

With the obstacles mentioned here there is little doubt regarding the difficulties which can be expected to be encountered when attempting to transition new and innovative technologies in the DoN Acquisition paradigm of today. In fact, within such an environment it would be a remarkable feat if technology were transitioned without extraordinary assistance.

Another interviewee, a civilian technologist from a SYSCOM PEO, provided roughly similar observations:

> Well, the POM-process for one. We live in that process … where we're going to now ask for the money in FY06 and quite often there are technologies available now but the technology readiness level that they're at is key. So we need processes that allow us to fund those systems while they look very promising at a TRL level of, say 3 or 4 – that's the NASA TR level – to take them up to a 6 or 7. Our sponsor is risk-adverse, and rightly so. He doesn't want to invest in premature stuff and he may end up dragging a large program along at a very expensive burn-rate or expense rate before the technology has proven that it's [useful] for his core function. And without new processes and additional emphasis on the ones we have we'll have difficulty moving it along. ONR certainly has had some excellent programs. I'd like to cite the FNC program and programs

> that don't have POM funding; they have transformation technology investments. They have excellent program inside of ONR and ONR needs to be reinforced in their funding availability as well as their authority to pursue those types of things. And we would like to see that happen, certainly within our PEO.

A number of remarks made here are equally important and relevant to this thesis. The DoD POM process was specifically mentioned as an obstacle in transitioning technology to the acquisition program. This acquisition office technologist identifies the need for a way to fund technologies while they are relatively "premature" (at a low TRL) until they prove their worth for the [PEO] sponsor's "core function." The DoN S&T account is intended, of course, to perform this function (fund technologies under development) but the key point here is the desire or need for funding only those technologies that will ultimately prove to be aligned with this PEO's "core function."

What is being asked for, by this acquisition representative, are technology options for conducting their missions in new ways ("transformation technology investments"). This representative indicates that portions of the acquisition community see a payoff in developing technology options without requiring the acquisition community to foot the bill ("ONR needs to be reinforced in their funding availability as well as their authority to pursue those types of things"). A problem arises, however, due to the fact the DoN S&T account services all Navy Acquisition PEOs. The difficulties that might be encountered when attempting to service the PEO communities S&T needs can be better appreciated through recognition that each of the SYSCOMs has multiple PEOs aligned with the SYSCOM mission areas and each PEO has multiple program offices (PMA, PMS, PMW) aligned to platforms acquired through the PEO for its mission. Most of these program offices, in turn, have responsibility for multiple weapon system platforms used to execute specific missions. Finally, each of these specific platforms has naval capabilities and specific mission requirements that could be enhanced by new technology developments. Expecting any organization to effectively service such a diverse community of naval missions, capabilities and requirements across the spectrum of the DoN, without clear priorities and guidance, is unrealistic.

When asked a different question about the importance of the Navy's S&T Program to develop options this same civilian PEO representative emphasized, "…we need new solutions to many of our warfighting problems … The technology is a driver. We have to get it out there and test it. We have to examine it, we have to look at it." Obviously the need is there, the problem becomes one of prioritization and execution.

When asked how we might be able to expand our current technology transition processes to incorporate cooperative system demonstrations the response from the Flag Officer PEO interviewee was:

> My viewpoint is you have to, again in a collaborative manner, determine what the end result is you want to be at and then you have to, in the beginning stages of a program, bring in all of the attributes of the program – the human interface, the actual warfighting capabilities of the system as well as the longevity of how you are going to maintain this system. You have to bring in all of the attributes at the beginning of the design phase. That goes back to the partnering between industry and government where you bring in sometimes non-traditional, from academia, from the commercial industry, so that we can not assume what the solution is but identify what the problem is and bring solution sets to it if we have a problem.

This response is in line with the IPT-approach taken by the S&T FNC Program: get the most appropriate stakeholder communities involved early in the development phase of the program. An important aspect of this remark is the mention of a need to "determine what the end result is you want." As obvious as it seems, knowing what is wanted is a fundamental component to the whole technology transition process. All important metrics (technical performance, schedules, resource requirements, etc) will be derived from knowing what is wanted as well as helping to determine how best to achieve the desired objectives.

With respect to the same question another Flag Officer commented:

> I think we've got to have money behind it from the mission point of view. If our money stays platform focused it will real hard to get capability-focused. I think if we can get OSD and others driving exercises and driving missions, not all of the money but some of it, I think it will help.

This comment again raises the importance of and the need for stable and reliable funding as well as the emphasis for an increasingly joint focus via OSD planning.

Another Flag Officer interviewee, an OPNAV Resource Sponsor, who was asked about the problem of transitioning advanced technology concepts into acquisition programs, offered the following comments:

> We need to fill identified gaps. You can get the best widget out there but if it duplicates a capability we already have there will not be a whole lot of interest.
>
> You need an S&T sponsor. We aligned around the FNCs and hopefully your proposal would fall within one of those FNCs or in some of the aviation, carrier, surface or submarine technology areas.
>
> Risk. Realistic schedules, balanced with risk and cost, are things we will look at. Secretary Young is looking at some ways to accelerate technology in that process but clearly risk has to be balanced as a part of that.
>
> How do you maintain requirements stability? Clearly it's all about money. We have worked very hard at getting realism into the operational requirements documents, the KPP's – the key performance factors – versus spiral development, which seems to be a new buzzword. What we've experienced in the past was people biting off more than they can chew in a given capability. Then we de-scope the program further down the line which does not lend you to requirements stability. Going after those core functions first and spiraling to those spin-off capabilities is probably a better way to go. Not ending up with the "gold watch" mentality. If you can tie these into an OSD or joint requirement they end up being much more defensible.
>
> The alignment of the Warfare sponsors with the resource sponsors has steadied the requirements out. The biggest problem we will have in the future is that as future defense budgets go they will drive our funding priorities and we have to adjust capabilities based on that.

These comments, made by OPNAV resource sponsor leadership, are critically relevant to the technology transition discussions of this thesis because they clearly illustrate the focus and importance of the resourcing (i.e., program funding) challenges being faced by OPNAV leadership and the possible impact these resource challenges can have on FNC IPT programs. As stated by this Resource Sponsor, stable program

requirements, a must for any successful development program, is directly linked to funding: "Clearly it's all about money." As problems arise ("…people biting off more than they can chew in a given capability…") the net result is that "we descope the program further down the line" and the repercussions of such decisions reverberate throughout the system. This observation is significant because under the FNC Process guidelines it is the OPNAV community, in its capacity as the Chair of each of the FNC IPTs, which has the responsibility to establish the warfighting requirements and for ensuring that DoN resources would be available to acquire the capability once it has been demonstrated. The S&T Chair of this IPT-lead process is responsible to design a project that responds to the requirements and delivers a solution within resource guidelines mutually agreed to. None of the new naval capability solutions under development seems likely, or even achievable, if the developmental system requirements are tied to funding fluctuations and do not remain stable.

During discussions about how the corporate sector approaches the technology transition issues the comment was made, "One of the first things that we needed to be was a very reliable partner in defense and to be very sure that when we make a commitment that that commitment was always met and that everybody would always have faith that it would be met." With respect to how can the government operate more like a business the response was:

> I think first and foremost is a valued partnership. I think that is where it starts. The specifics of that are probably having to do with the joint sharing of needs and those could have a few specifics of their own. Like roadmaps. The one thing we would like to do is get our technology investment aligned with Navy needs. So if we could get our joint roadmaps where we could debate and agree on and get our investments, joint investments, aligned around them it would be best.
>
> Some acquisition streamlining, of course. At companies such as [ours] we only have a fixed amount we can spend on business ventures and every dollar we spend on responding to proposals or things of that sort is a dollar that we don't spend on the warfighter. Streamlining the acquisition process would enable dollars to be spent on warfighter needs.
>
> And I think cross-learning. We probably spend a lot of time as an industry trying to understand the needs of folks in PEOs and organizations like

> [OPNAV] N7/N8 and the pressure that those folks are under. Some of that the other way so that we could be partners in meeting each others needs I think would be helpful. But overall, we see the need for speed and agility and that really is through partnership.

The items mentioned by this industry representative mirror, almost identically, the needs expressed by DoN personnel. From this input the Navy's technology transition process needs are seen to be not very different from those of a typical major corporation, if different at all. The items mentioned by this corporate executive include a joint sharing of needs, the importance in aligning [corporate] technology investments with those needs, a debate and agreement among stakeholders on the level of investment required to respond to those needs, simpler acquisition processes and a "valued partnership."

1. Summary of Personal Interviews

Sixteen interviews were conducted with high-level personnel across the stakeholder spectrum. Most persons interviewed were at the active military Flag-officer, civilian Senior Executive Service (SES) or commercial Vice President (VP) level. A more detailed breakout of the 16 persons interviewed would be as follows:

- 4 military officers (3 RADM Flag Officers, 1 CAPT. All were active)
- 4 civilian Senior Executive Service (2 retired, 2 currently active)
- 1 political appointee (a former ASN(RDA))
- 2 industry representatives at the Corporate Vice President level (1 large defense company, 1 small industrial company)
- 5 senior civilians at the GS-15 level (2 OPNAV, 2 S&T, 1 Acquisition. All were active.)

In all cases those who were approached agreed to be interviewed and all offered insights into the technology transition process with respect to their position, experiences and observations.

Most, but not all, of the interviews were recorded. All of the interviews were conducted in an informal manner and were intended as a comparative source of information to the data captured through the e-mail surveys. In one instance the data

from a recorded interview was lost due to a recording problem.[218] All of the interviews were reviewed for content and some of the recorded interviews were transcribed to capture exact quotations for reference in this thesis.

Interviewees provided valuable insight regarding senior-level management thoughts on DoD and DoN efforts to operate in a more business-like manner in general and the effectiveness and utility of the FNC technology transition process in particular.

D. SURVEY RESPONSES

In an effort to collect credible feedback on the FNC Process a survey was circulated via e-mail to persons who were knowledgeable of and participated in the FNC Process. The intent was to obtain credible feedback on the FNC Process from persons who were involved in the process and knowledgeable of its goals, objectives and processes. An attempt was made to request feedback equally across all stakeholder communities in order not to bias the conclusions through a disproportional response rate from any particular community. Obtaining feedback on the FNC Process presented some challenges. In a very large number of cases key personnel had moved on to different jobs or retired from civilian or military service. Personnel turnover was found across all communities but most frequently within the OPNAV Requirements community where IPT Chairs, Military Requirements Officers and civilian detailees were in frequent rotation. It appears that a large number of key S&T personnel also turned over (left for other jobs or retired) as the FNC Process evolved.

There were also a few persons who declined the opportunity to provide feedback on the FNC Process mostly out of what appeared to be a high degree of frustration with the process and a lack of desire to expend any additional effort on what they viewed as a futile paper exercise. As one person remarked:

> I am embarrassed I was ever a part of that process. I don't want to be associated with it any more, in any capacity. Now I belong to an organization that cares about their people and knows how to conduct its business. I don't ever want to look back again.

[218] In this instance the battery drained shortly after the interview started.

1. OPNAV Community Response Analysis

Survey responses were received from two IPT support categories (Principal IPT member and Working Group member). Due to the nature of the OPNAV role in the FNC Process receiving responses from only these two IPT support categories, for the OPNAV community, is considered reasonable. The survey response ratio (surveys returned/requested) was 38.5%.

a. General Questions

Respondents identified three different customer categories with respect to the FNC Process (the OPNAV and acquisition communities and the warfighter) and described the FNC Process' connection to the deployed warfighter (Fleet/Forces). There was agreement, among those that elaborated further, that the acquisition community is the immediate customer charged with the responsibility to deliver a capability to an end user, the deployed warfighter (fleet). Several respondents commented on the importance of the acquisition community to the FNC Process. One respondent remarked "the acquisition community owns the process to deliver capability to the Fleet." Again referring to the acquisition community, another respondent remarked:

> they are the folks who must take the result of the S&T and 'engineer' or design the technology into a system or component so that technology can benefit the warfighter.

All agreed the goals and objectives were explained to the OPNAV community. There was some criticism, however, with respect to the adequacy and effectiveness of the understanding of those goals and objectives within the OPNAV community. As an example, one respondent commented:

> [T]he current FNC goals and objectives are somewhat confusing and those goals, objectives, processes and overall FNC background are very poorly understood within my community of warfare requirements.

Another respondent drew a direct connection between an apparent lack of OPNAV buy-in of the FNC Process, as evidenced by OPNAV questions, poor project execution and the resulting funding reductions observed throughout the FNC Process:

ONR has not followed through on the execution and delivery of the S&T product. Hence all of the questions by OPNAV and associated reductions.

A contributing factor to an apparently suboptimal level of awareness (of the FNC Process goals and objectives within the OPNAV community) would be the degree of personnel turnover within the OPNAV community. An observed high personnel turnover rate is commented on by these OPNAV respondents as well as by respondents from other stakeholder communities later in this chapter. Personnel turnover rate, by itself, does not tell the whole story since much more depends on the quality of personnel assigned to the tasks. The fact that there is a high turnover rate, due in part to OPNAV's use of military personnel and civilian detailees who rotate through job assignments on a fairly frequent basis, provides an environment of instability. It is difficult to generalize because, depending on the qualities of the specific persons involved, this may be good or bad but it is always changing. Data capturing the actual turnover statistics for the FNC IPTs was not collected and an analysis of the impact personnel turnover(s) had on the FNC Process is beyond the scope of this thesis.

Respondents indicate the impact of the FNC Process within the OPNAV community has been largely minimal. As a caveat to this impact assessment one respondent emphasized the FNC Process is a recent change to previous DoN processes and so it would be "unreasonable to judge the output of a process which has not had sufficient time to generate an output." While this is certainly true for the FNC Process as being studied in this thesis it would not hold true for the Navy's technology transition process in general (when looked at over longer periods of time).

There were both positive and negative aspects to the respondents' impact assessments. One positive aspect mentioned was a delay in the reduction of S&T dollars in the budget cycle. It was commented that "the concept of maintaining a level-funding stream to reduce the burden on managers of efforts was one of the pillars of the FNCs." With the FNC's original resource allocation of one-half of the DoN S&T Program budget being reduced to a level close to a lower cap of $500M (between one-fourth and one-third of the S&T Program budget) it is questionable if such a 'level-funding stream' has been realized.

Other comments made addressed more fundamental business concerns such as Return on Investment (ROI), the number of management reviews and declining funding levels:

> The impact so far is that we are expending a large amount of effort which appears to have little return on investment. We participate in a unending chain of reviews and nothing ever seems to change except for a reduction to the FNC funding and their associated program cuts.

There was also some criticism of ONR's management of the S&T execution dollars:

> ONR has routinely reduced dollars available to the FNCs to execute. Why is that – OPNAV has not reduced the dollars available to FNCs. Where are those funds being diverted and how are they being better used to support the customer?

Although the FNC Process is an (OPNAV) requirements-driven process, survey respondents did not report the high degree of engagement through the IPT that would have been expected. Responses such as "minimally" and "overall FNC resource sponsor" seem to down-play the importance of the OPNAV role in the FNC Process (establishing requirements, serving as Chair for each of the individual IPTs and planning/programming fiscal resources). OPNAV representatives play a central role in the FNC Process but their ownership of this role and the method through which they exercise their authority appears to be mixed. A comment made by another respondent mentions another mechanism through which OPNAV personnel participate and attempt to influence the FNC project selection process:

> The submarine community engages the FNCs generally through the SUBTECH process and through participation in the N706 and pillar assessments.

This comment refers to another requirements review process within the Navy and indicates that attempts are being made to integrate some of these other efforts with the Navy's S&T investments being decided within the FNC Process. This comment refers to the SUBTECH process which services the Navy's submarine community. Other similar requirement review boards and processes would include NAVSEA's SURFTECH

process, for the Naval Surface PEO community, and NAVAIR's ATRB Process, serving Aviation PEO interests.

In response to the question asking how important the FNC Process was to OPNAV operations the responses varied but were generally positive. One respondent saw importance in the IPT decision-making forum as "A means to define and deliver a valued product to the customer. A 'peer' product definition and review process.[sic]" Another respondent viewed the FNC Process as a critical mechanism for the Navy to maintain its warfighting superiority but did not feel the process had been implemented effectively:

> The FNC Process is critical to maintaining our technological edge. Unfortunately, in its implementation, the FNCs have not focused effectively on meeting our needs. So, the FNC Process is critical but the current program being executed is not meeting our critical needs.

b. Transition Questions

With respect to the fundamental issue of transitioning technology to the warfighter none of the survey respondents expressed strong confidence that programs would transition, at least as originally planned. One example of a response:

> I don't think that we predict transitions very well. However, I think that most of the work will transition … just not as planned.

Funding reductions were also cited as a reason for missing transition windows, or the cancellation of programs entirely:

> Unfortunately the ONR taxing schedule and fees have delayed or eliminated a significant number of the original transitions. The taxes have caused the FNCs to cancel, rescope or alter the program plans under false fiscal requirements.

In response to the question asking where the FNC projects would transition to most respondents were of the opinion that the projects were being transitioned to current acquisition programs of record ("Those programs that already had the funds" and "… to 6.4 and 6.5 R&D"). Another comment suggested transitions were being made to "Pet projects or politically inspired". The charge that projects are transitioning to 'pet projects' is somewhat subjective and more difficult to pin down but

the remark made about ‘politically inspired’ projects can be examined with some objectivity. The increasing number of congressional plus-ups over the past several years, shown in Table 1 (page 217), would be an example of one metric that seems to provide some credence to the comment made.

There was not a lot of feedback provided by respondents offering examples of transition metrics being used by the various IPTs. This general unawareness is an indication the establishment and use of appropriate project transition metrics remains a problem within the FNC Process. One comment offered:

> It varies by IPT. Some (such as TOC) do a “return on investment” analysis so their metric is dollars. Others rely on warfighter assessment of greatest need. Still other IPTs accept the ONR program manager input without much questioning.

The two biggest obstacles to transitioning technology as planned, according to the OPNAV respondents, were related to budget and personnel instabilities. With respect to budgeting problems one respondent cited “Zero-growth budgets” as an obstacle and another remarked that:

> ONR siphoning off funds to pay “taxes.” The funding reductions have required the IPTs to change scope, cancel projects, and delayed delivery and [extended product delivery] timeframes.

With respect to personnel issues a respondent cited an “inability to maintain stability in personnel (at OPNAV principally) and budget processes that don’t allow for the introduction of new things easily.”

Respondents indicated there was not a general agreement on project maturity, cost and schedule. For the FNC Process the lack of agreement on these metrics is a serious issue since these agreements are the primary basis for the transition agreements between the S&T and acquisition communities. The biggest issue, from the respondent comments, was with the technical maturity level of the programs. An FNC IPT projects’ technical maturity level is estimated using NASA’s Technology Readiness Levels (TRLs). For the FNC Process one respondent commented, “the TRLs, for

transition, have a fairly wide spread. Different communities have different standards that they are used to in accepting transitions." Another respondent commented:

> ONR has allowed the efforts to be turned over at TRLs greater than prescribed by the BA level. This was done in most cases to persuade the acquisition community that the technology solution will meet their requirements.

With respect to collaboration efforts among the IPTs most of the OPNAV respondents were unaware of any collaboration efforts. Only one OPNAV respondent offered any evidence of IPT investments being shared:

> There are only two cases of any significance where a product relies on contributions from two FNCs. [Anti-Torpedo Torpedo] ATT has the weapon and the sensor in two different FNCs and turbine engine technology is funded in two places. However, there are a large number of dependencies in the sense that, for example, time critical strike relies on developments in KSA for there to be an overall improvement in strike capability. In fact, KSA provides the communication's for many other developments to be utilized effectively.

What is significant here is that the two programs mentioned in this comment (ATT and turbine engines) are also examples of programs where significant technological strides have been made over a number of years. Some survey respondents indicated they were aware of areas that were receiving joint funding and named a few specific projects. For example, the Integrated High Performance Turbine Engine Technology (IHPTET) project, the Advanced Amphibious Assault Vehicle (AAAV), and the Navy's Uninhabited Combat Air Vehicle (UCAV-N) were all identified by respondents as joint projects. It is significant to note that none of these programs are funded jointly due to an IPT-initiated action. They are jointly funded because of previous funding agreements or are special-interest items. From participant responses there does not seem to be any evidence of IPT projects being funded jointly as a objective, goal or pursuit of an FNC IPT.

c. Process Questions

Respondents provided mixed responses to the question asking if the IPTs have been effective. One respondent felt the IPTs have been effective, commenting that the IPT process has:

> … brought the 3 communities together (Acquisition, OPNAV, S&T). I did not include the "Fleet" as I believe their investment horizon is based in the acquisition community and not in the FNCs. The FNCs are a 2-10 year delivery window to the Fleet after technology transition to the acquisition community.

Another respondent provided a more mixed assessment of the IPTs across the board. This respondent has observed that the differences in IPT effectiveness across the FNCs have been largely a function of the time and effort sunk into the process by the IPT Chair:

> Some have; others are not (I've been on 5 IPTs). Some used to be effective but have become ineffective over time. It all seems to depend on the willingness of the Chair to spend the time to listen and exercise judgment to actively manage the program. The good IPTs have chairs that invest the effort and strive to get a balanced OPNAV input. The bad ones 'rubber stamp' the ONR execution manager program without even bothering to synthesize the overall OPNAV input.

The IPT effectiveness question is best summed up in the comments of another respondent; the IPTs have provided a "Good dialog but execution objective still weak."

The decision-making process within the IPTs seems to be a complicated dynamic. Most respondents indicated decisions were made in a consensus manner, based upon group discussions. For example, one comment made was:

> Consensus. Much discussion on the ramifications of the decisions. Lately though, since Dec 02, it has been done somewhat unilaterally by ONR. The remaining IPT members have been lead along with the "short" fuse responses.

Other comments made indicate some of the IPTs are operating inconsistently. The observation provided by a different respondent, for example, indicates some IPT decisions may be of a more 'directed' nature than consensus-based ("The one with the most stars wins"). Another response to this question was:

> Varies … consensus in some while it's directed in others. The charter for IPTs specifies that they act through consensus but it would appear that most chairs don't understand that concept.

From survey respondent observations IPT personnel have turned over, roughly, between three and six month intervals. As one participant has observed:

> On average, I'd say that there is a change to each IPT every six months. Certainly, it's rare today to find anyone who can remember why or how the program was initially formulated in any FNC. The most stable element (the N911 rep) has now officially disappeared so there is absolutely no corporate memory on any of the IPTs.

Other respondents provided "quarterly" and "every 6 months" estimates while some indicate slightly longer durations:

> The TOC chair, S&T Lead and Resource Sponsor has remained the same since the inception of the IPT. The acquisition rep has changed three times (averaging about 13 months). LASW has rotated quite a bit. AO has rotated quite a bit.

Not much insight was provided regarding how the IPT portfolio was selected. The only comments made by the OPNAV respondents were "existing ONR projects" and "varies." This seems to indicate, for the most part, that respondents view the original IPT portfolio as largely a reflection of S&T projects that were already underway.

Most respondents indicated they knew of no process for the selection of new programs within the FNC framework. From an OPNAV perspective this opinion, although being expressed fairly widespread across all respondents, would not be completely accurate. For OPNAV the (new S&T program) issue is two-fold; 1) doing the resource planning to ensure that funding is available for those new programs and 2) selecting the new programs themselves. The task of securing OPNAV resources to pay for new programs in the outyears is an essential component of the new program process. Without ensuring resources would be planned for and made available there would be no reason to select new programs. When most think of a process for the selection of new programs they think of the selection of the specific programs themselves with the underlying assumption that OPNAV has the resource component of the equation figured out. This, however, can be a poor assumption as evidenced by the drain on the S&T

resources. OPNAV was in fact planning resources for new programs in the outyears. As one participant comments:

> There was a process that N911 was going to implement but now that there is no N911 there isn't anyone who knows what was intended. But, in a nutshell, there were funds set aside beginning in FY-06 to begin new FNCs. Selection of new FNCs was scheduled to support the POM-06 process. This was also necessary to let the FNCs startup and see where the problems were before committing any additional funds. This could have been a hedge against any sever execution problems in the existing FNCs.

With the recent changes in OPNAV N911 there is valid concern over how the important issue of resource planning for the DoN S&T account will be handled in the future. Having a full-time OPNAV S&T advocate who is knowledgeable of S&T processes, issues and concerns and takes ownership of these S&T issues when difficult decisions and trade-offs need to be made is critical to the long term health and vitality of the DoN S&T account. With all of the recent changes it is not clear, at this point anyway, where that OPNAV advocate role resides. As one survey respondent summarized, "… there was a process but there doesn't seem to be one today."

For the selection of the specific programs themselves there is evidence that at least some of the IPTs had a process, although the details of their individual processes are apparently not widely known outside of their Working Groups. Such a process, which one participant mentions, was based on the fact that "the cut list from the original submitted program is an excellent starting point." This process was used by a few of the IPTs (KSA and TCS, for example).

d. IPT Meeting Questions

All of the OPNAV respondents were informed, and regularly attended, the IPT meetings. Discussions with participants reveal that when the FNCs were first being established the IPT meeting frequency was very high but that, as time passed, the meeting frequency has dropped off considerably. This is reflected in a remark made by one of the participant who observed that IPT meetings "Started out weekly, then monthly, then every two months. Now it's about 3-6 months." Other, more recent, participants provided an approximate 6 month meeting frequency figure.

For the most part, OPNAV respondents confirmed all stakeholder community representatives attended the IPT meetings either in person or via VTC. There was a distinction made between IPT members attending IPT meetings and other (non-IPT) representatives attending the IPT meetings. The distinction made was:

> IPT members attend IPT meetings. If the members are doing their jobs, they are getting community input BEFORE they sit down at an IPT meeting. IPT members participate in IPT meetings. This has nothing to do with any community designations.

e. Communication Questions

Respondents were mixed in their assessment as to whether or not they felt they were kept informed of relevant S&T information. One respondent thought so, two thought they were not and another indicated "sometimes." The comment made by one participant was:

> What is the definition of relevant? Many of the S&T initiatives to address the capability shortfalls were ONR efforts to begin with. I am not aware of any executed effort that was not funded by ONR in 2001. The acquisition community representatives are not involved in the issuant [sic] of BAAs or evaluating the proposals. So the short answer would be no.

Respondents indicated they went to ONR (Deputy PM and Execution Managers) and the IPT representatives for needed FNC information. In response to the question asking if there was any information respondents felt they needed but did not have the most piercing stated need was for "a true prioritization of requirements." This response is interesting because it comes from the OPNAV community, which was itself charged with the responsibility to do the requirements prioritization for the FNC Process. Within the DoN FNC Process the S&T Community would develop programs in response to valid Navy requirements. This comment reveals a frustration, from within the OPNAV community, stemming from the inability of OPNAV to direct the FNC Process as originally envisioned.

Survey responses indicate the S&T website has not been widely used within the OPNAV community. One respondent acknowledged using the website only seldom (monthly) and two others indicated they almost never use it. Responses such as

"minimal" and "useless" indicate the S&T website is obviously not viewed as a useful tool within the OPNAV community. At the working level, a sense of frustration and some level of distrust between the OPNAV and S&T communities are evident in the following comment:

> The important information is/was removed by ONR comptroller (hardly an open book) since it was considered not in the best interest of ONR to have an audit trail (funds, decisions, history and free thought).

The frequency of interactions between respondents and the S&T community covered a wide range. Responses varied from weekly, monthly to bi-annually (every 6 months) and included a less quantifiable response, "whenever they wanted." Such a large variance in the frequency of interactions seems unusual and might be caused by a number of things including the small (respondent) sample set and the fact that some of the respondents all less engaged with the S&T community due to their having moved on to different job assignments. It is also possible the variance is an accurate indicator of the OPNAV community's level of engagement within the FNC Process. Such a variance implies the FNC IPTs differed significantly among one another in their interface to the S&T community. If such were the case it would be interesting to explore the relationship between the level of engagement between the OPNAV and S&T communities and the "success" of those IPTs. Such an investigation is beyond the scope of this thesis.

f. Satisfaction Questions

All respondents expressed some level of dissatisfaction with the FNC Process. Within one of the comments there was an indication of some hope that the FNC Process would herald fundamental changes to the way S&T does business ("Initially – sort of, later – no") that has not fully materialized. Along these same lines was another comment made that it (the S&T process) was "back to business as usual." Even with the dissatisfaction there was another remark made was that it (the FNC Process) was still an improvement over the pre-FNC ways of doing business.

The aspects of the FNC Process which were cited as 'working' were the greater awareness of S&T investments and the senior level engagement that the process

has arranged. One respondent summed it up as "getting the stakeholders together" and another observed "there is far more visibility into the S&T program today than there was 5 years ago."

The cross-community dialog, via the twelve FNC IPTs, was formalized at a higher level (flag level) than previous transition processes. To some degree such a high level dialog had the effect, as commented by one participant, to help justify the S&T investments and, effectively, defend the S&T Program "against OPNAV attack."

These positive attributes of the FNC Process were realized through the formation of a number of independent FNC IPTs. There are questions regarding the effectiveness of IPT operations. One participant suggested "OPNAV leadership is correct but the IPTs are at too high a level to devote the time necessary." Even though the process might be fundamentally correct there is still an issue with the IPT being at too high a level to devote the time necessary to manage the process effectively.

There were several opinions offered as examples of aspects of the FNC Process that was not working. In no particular order those items suggested by the OPNAV respondents are summarized as follows:

(1) ***Investing in Naval Needs***. A core component of the FNC Process is that Naval S&T resources would be directed toward solving high-priority naval needs. Yet one of the comments submitted, "Redirecting ONR funding toward needs," suggests this remains an area of concern. A different comment made, "too many people try to apply their parochial standards to the FNCs and don't ever bother to concern themselves with the scope of the S&T that Navy has to pursue to fulfill it's widely varying missions," suggests the problem is rooted in the biases of those participating within the framework of the process.

(2) ***IPT operations***. One of the comments made suggests the IPTs have been ineffective due to the fact that the decision-makers are too disconnected (grade-wise) from the working level members who actually have responsibility for assembling the IPT project portfolios: "OPNAV leadership is the right thing but it's at too high a level to spend the time required to make intelligent oversight decisions." A

similar comment made expressed awkwardness in "Having one and two star admirals justify their decisions (IPT programs) to 0-6s."

Originally the IPT structure was championed as having the OPNAV Requirements Chair speak for all requirement communities. Attendance sheets from early IPT meetings reveal multiple OPNAV representatives would be in attendance, to advance the interests of their community. Over time the perception has changed to where the IPTs are viewed as being "owned" by the community from which the Chair comes from. This morphing of the focus of the IPT over time leads to participant comments made voicing concerns of the "Inability of the principals to look outside of their respective domains (ships to consider aviation; tactical versus logistics; and so on)." The shift in the IPT emphasis areas to one where they are directing the IPT investments towards one warfighting community rather than pursuing a more broad naval emphasis leads to another concern voiced by an OPNAV participant, that of the appearance of "Stovepiping of product lines within the IPT selection process."

There is no doubt the FNC Process increased the level of awareness of the S&T Program with the OPNAV community. By virtue of the implementation approach taken, the IPT consensus-based decision-making process, there was a greater awareness within the acquisition community as well. As might be expected a natural consequence of this arrangement is an increase in the bureaucratic oversight process caused by adding layers of review and responsibility. Because of the involvement of different organizations (OPNAV, HQMC, S&T, SYSCOMs, etc) the net result is a confusing set of difficult inter-organizational processes that become virtually impossible to satisfy without a willingness to compromise. One comment made was there are now "Too many people now have to do separate reviews because there is no single S&T oversight organization in OPNAV to coordinate reviews."

(3) ***Funding***. A perceived level of inadequate funding has been a shortfall cited by many throughout the FNC Process. As one respondent has observed, the "funding of FNCs has been a dismal failure from the beginning. Too many FNCs were funded so they have inadequate resources. This was a basic failure to down-select at the start." "Any and all taxes levied. These were allocated in the plan." The

"blue vs. green" funding issue was mentioned in a comment as well, "Navy dollars funding USMC programs at expense of Navy programs." A final resource-related comment made cited the observed high cost of administering the FNC Process, "ONR spends too much on an inflated and unnecessary FNC bureaucracy."

(4) ***Accountability***. A fourth category raised accountability concerns. One comment made, "IPTs don't hold ONR responsible for their execution," suggests serious execution issues persist and implies the IPTs have not been able to manage these issues effectively. Another similar comment, "ONR appears to do what it wants," also suggests that operations are run somewhat loosely.

The most important aspects of the FNC Process mentioned were the "cross community communication" it has generated, the "stability and OPNAV oversight" of the transition process and the fact that the naval community, in general, is "getting visibility into ONR decision-making/results."

g. Additional Comments

Comments submitted by representatives within the OPNAV community fell into three distinct general areas; 1) those dealing with process concerns, 2) those raising concern over the use of the Navy's S&T resources to pay for management costs and 3) those providing comments on the usefulness and limitations of the FNC Technology Transition Survey itself.

(1) ***Process Concerns***. One of the comments made relates to the fundamental issue of the continuing difficulty in achieving an investment balance across the S&T account. The comment, "there still remains an element of 'game playing' which appears to be motivated to secure the most $$ vs. what's right for the fleet," correlates to other similar comments made elsewhere within this thesis (for example, numerous "stovepipe" remarks) and is an indication these problems remain.

A number of comments were made regarding the issue of 'transition.' One comment made points out "it has been said that there is insufficient resources in Navy Acquisition TOA to truly transition the number of products pursued by the FNC program."

Another comment made suggests the FNC Process places too much emphasis on trying to guarantee transitions:

> Over-emphasis on transition – transition argument is disingenuous. Needs to be revisited & redefined. Evidence of S&T product in Acq[usition] community POM submittal unrealistic. Few current important capabilities were 1st driven by a requirement.

There are several items of interest within this comment. The emphasis on transitions stems from the FNC mandate that significant S&T financial resources would be applied to solve problems that address warfighter needs. For those with significant experience in the technology development "business" the realities of the transition process have not been as straightforward as the FNC Process strives for and suggests. This disconnect suggests the FNC Process' rationale and emphasis for the need to show a transition itself is tenuous, possibly leading to the respondents' "disingenuous" perception. The suggestion to revisit and redefine transition expectations is a good one and appears to be based on the experience that important naval capabilities (i.e., past "transitions") were not achieved as the result of a highly structured requirements process using customer transition agreements negotiated years in advance. To be effective any future technology transition "expectation" discussions would need to be open, candid discussions at the flag/SES level with all stakeholder communities participating.[219]

This participant has observed that showing a transition, as evidenced by the S&T product appearing as an acquisition program POM submittal, is "unrealistic." Part of the issue is one of timing (the S&T program selection processes do not necessarily align with Pentagon internal POM schedules) and part of the issue is a consequence of the budgetary pressures of the OPNAV and acquisition community weapon system procurement trade-off compromises which occur up to the 11th hour of the due date. Expecting a (relatively) long-range S&T project to influence next budget cycle financial decisions is, in fact, highly unrealistic. The respondent suggests, "If ONR wants to transition it should look at its current set of 6.3 products and begin packaging these to solve acquisition community needs."

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219 For the FNC Process there has been no evidence found that such transition "expectation" discussions were ever held with all stakeholder community participants; the FNC Process appears to have evolved out of VCNO/CNR discussions and was initiated without cross-community deliberation. The fact that there have been a number of significant acquisition issues with the FNC process supports the suggestion that a discussion of expectations be held.

(2) ***Management Costs***. Another sets of comments provided focused on management costs, the high degree of administrative support which has been used to support the FNC Process and questions the appropriateness of using S&T resources to pay for such support when ONR receives funding outside of the S&T budget "to pay for the management of assigned S&T programs; including personnel salaries." The issue raised is concerned with the increased amount of administration consumed by the FNC Process even though the Process itself has brought no new resources to the S&T account:

> It is therefore reasonable to expect that ONR could manage the FNC allocated funds with roughly the same number of personnel; which was possible prior to the FNC establishment. Nevertheless, they have seen fit to increase staffing by setting up a fairly robust additional management structure for the FNCs. Rather than reassigning current ONR personnel to fill these positions, they have elected to bring in a substantial number of IPAs, contractors and detailees. These people then charge to the dollars allocated for the various FNC projects for which they are to manage.

The increased staffing levels referred to, however, were more likely an unintended consequence of the increased oversight from the various stakeholder communities rather than a scheme to dilute the development work being done within the S&T account. With the immediate and intense emphasis on securing acquisition program 'transition agreements' over the FYDP it is probably not reasonable to have expected traditional ONR (BA1, basic research oriented) employees to step in and fill the numerous (independent) program support positions created by the establishment of twelve independent IPTs. The real oversight seems to be that this rapid increase in staffing was completely unanticipated and, as such, there were no provisions made to fund these new support positions. The only sources of funds were the IPT resource accounts themselves. This points to another concern raised in the survey, the negative impact of using S&T resources for these management and administrative support tasks:

> In an environment where S&T dollars and their associated buying power has been on the decline, ONR is exacerbating the problem by diverting S&T execution funds to an increasing amount S&T management funds. This management initiative results in fewer research dollars leaving Ballston Tower.

The net result of the increasing management costs of the FNC Process is a reduction in the amount of funds available to execute the tasks and deliver the desired new capabilities. As one respondent observed:

> This is a significant drawdown of critical funding which the resource sponsor expected to be available for the actual conduct of S&T efforts versus salaries. Only now are the FNC IPTs beginning to ascertain the reduction in FNC transitions that can be supported due to this whittling away of the dollars. When coupled with the expenses for the new unfunded FNCs and the "other" withholds, there is a significant reduction in FNC productivity and capabilities lost.

(3) ***Survey Limitations***. A final set of comments focused on the survey itself and the problems and shortfalls in attempting to capture a balanced set of meaningful data when using surveys rather than interviewing personnel directly. As was commented, "These surveys always make me exceedingly nervous because you are bound to accept the answers of the uninformed and the ignorant along with the knowledgeable and you probably can't distinguish between them." This point is certainly true and is a legitimate limitation of the data collection approach taken for this thesis. The survey format was chosen as one data collection method for this thesis for a number of reasons, one of which was convenience. By sending out a broad survey to a wide distribution I could collect answers to a large set of questions and could compare responses to the exact same questions. I could also collect responses in a directly usable format (transcription not needed). As was mentioned earlier, an attempt was made to seek out the input of individuals who were directly involved in the process and so were familiar with the many aspects of the process. For whatever reason many of those individuals declined to participate, greatly limiting the available data set. The participant survey, however, represents only one method of data collection used. Other mechanisms were used to broaden the type of data collected and, hopefully, correlate findings by using data from independent sources. Other data collection methods included personnel interviews and the collection of statistics.

Another comment made, regarding the FNC Process and how it took shape, was:

> I suspect that most of your respondents have no knowledge of the objectives and goals nor any knowledge of the initial charge by VADM Pilling to N091 to initiate the process. In fact, most folks in ONR were completely unaware of what N911 was up to with respect to FNCs for roughly the first six to eight months of effort. Only [Dr. Fred] Saalfeld and [RADM Paul] Gaffney were knowledgeable of everything that was being done. This void has been filled by urban legends which are not even remotely accurate.

Certainly what is said here is true, too: most involved in the process became involved long after the initial discussions among the senior naval leadership (CNO, VCNO, CNR, ONR TD/ED) were held.

2. S&T Community Response Analysis

Responses were received from each of the four FNC support categories (Principal IPT member, Working Group member, Project support and Other support). The survey response ratio (surveys returned/requested) was 63.6 %.[220]

a. General Questions

Responses to the question asking "who is the customer?" spanned the entire RDT&E spectrum. OPNAV, ONR, acquisition PEOs, PMs, and SYSCOMs and the warfighter were all listed by respondents as valid S&T customers. Although each of these separate communities was viewed as an S&T customer, the acquisition community was identified as the customer most often. As one respondent remarked:

> ... the purpose of the FNCs is to demonstrate the maturity (and mature [it] if necessary) of a particular technology or set of technologies to support their introduction into a SDD program either in total or in part. As such, the customer would be a PMA or PMS ultimately.

Among those within the S&T community the responses were not unanimous either. Another respondent, from the perspective of a NRE S&T representative, felt the customer of the FNC Process was "unmistakably" ONR itself. Two other survey respondents listed multiple communities as customers and still another

[220] For the S&T Community, there were 11 survey requests made and 7 surveys were returned. Requests were made to Navy and Marine Corps members (military and civilian) of FNC IPT members and FNC working group support members. Survey requests were made from approximately one-half of the FNC community and the survey responses received covered roughly one-third of the FNC community.

identified the warfighter as the customer. None of the respondents suggested OPNAV as being a (sole) customer. These responses (to the "customer" question) are interesting in light of OPNAVs central role in the FNC Process (OPNAV flag officers serve as Chair of the FNC IPTs) as well as due to the fact that the fundamental restructuring of the FNC Process was founded on the S&T community building their projects in response to naval warfighting requirements and priorities decided upon by the OPNAV community. From a purely "business-process" perspective the fact that there is no single, recognizable, customer identifiable by those involved in the process is an indication of confusion and should be cause for some concern. In the case of the S&T Program this confusion stems from the Defense Departments' research, development, and acquisition processes and the overlapping roles played by the various communities that are involved in the processes.

There was unanimous agreement among all respondents that the goals and objectives of the FNC Process have been adequately explained within the S&T community. The assessment of the impact the FNC Process has had within the S&T community was mixed. Most respondents provided a positive assessment, overall, but there were also some issues raised. For example, one respondent provided a negative impact assessment based on the (declining) amount of work being done at Labs within the NRE community. For this person the FNC Process has had:

> Quite a dampening effect. In theory, the FNC Process should "focus" efforts on identified requirements; in practice, the focus of resources (i.e., money) on key favored industrial partners seems to have frozen or eliminated a significant portion of Navy Lab S&T work.

Another respondent felt it was too early to evaluate the impact of the FNC Process but expressed concern over continuity within the S&T account:

> I think that the process has had little impact as yet. The primary reason for this comment is that it is too early in the FNC's life to determine if it will successfully transition technology to programs. I'm also concerned that there lacks continuity between the 6.1 and 6.2 world such that new concepts would flow from research up.

Similar continuity, program planning, and system engineering issues were expressed by other respondents in their "additional comments" remarks. The most

positive aspect of the FNC Process has been the increased visibility of the DoN S&T investments and an increased dialog regarding those investments. The areas affected most were those programs farther along and closest to a transition window of opportunity. Understandably these would necessarily be predominantly the stakeholders of current programs of record (POR). This observation was supported by the survey responses. Because of the uncertainty involved, when looking beyond the current POR time horizon the reliability of any impact assessments of the FNC Process becomes much more questionable.

With respect to the overall importance of the FNC Process many of the respondents were divided in their assessment. Responses ranged from the lukewarm "probably not very much" to "highly important to continue technology advancement and demonstration." Another remark emphasized the importance of maintaining credibility and trust: "If their promise is kept, they could be an extremely important source of technology to feed new concept improvement and development."

b. Transition Questions

Most respondents were not confident the FNC Process would transition programs as originally planned. The respondents' lack of confidence is noteworthy since the question of transition is at the very core of the FNC Process and was one of the primary reasons for restructuring the Navy's S&T account. One respondent conveys doubt over whether FNC transition rates would show any improvement over previous process transition rates (i.e., Navy ATD transition rates):

> Discussions with some PMAs and S&T practitioners suggest that the general sense is that transition rates won't be noticeably better than before the FNC Process.

Other respondents also expressed doubt regarding the FNC Process' ability to transition products, citing difficulties such as budget and schedule fluctuations. Another respondent was more positive and suggested that even if the planned transitions were not achieved as originally planned there might still be transition opportunities. In such instances the determining factor might hinge on the ability of the S&T community to accept new inputs and recognize new transition opportunities wherever they may arise:

> … I am equally as confident that there exists opportunities for the technology demonstrated to find transitions outside of their plan. If the only metric used is the metric of meeting the planned transition, then there is a significant risk that the majority of the FNCs contributions to systems will not be accounted for when measuring their value.

Regarding the use and identification of metrics, survey responses were split between those who cited the use of TTAs as the primary transition metric and those who had not seen any published metrics or stated they did not know of any transition metrics at all.

The acquisition process stood out among respondents as being the current major obstacle to transitioning technology as planned. A number of different reasons were offered, from a lack of "stable S&T funding" to a more subtle but equally disruptive "acquisition manager's lack of real interest." Another respondent commented on how the acquisition process seems to favor contractor-developed incremental solutions over competitive solution options that would be seen as a threat to the current POR:

> The system is not put together to easily accept technology generically demonstrated under the FNC program. Frankly, I feel that the system dis-incentivizes the transition. To try and quickly summarize, it is my opinion that the contractors working military systems are incentivized to fail as they continue to be paid for failure while success completes a program. As such, new technology that will improve things not specifically developed by the contractor is not easily inserted into a program being executed by a contractor. There are examples of this. If you wanted to significantly increase the percentage of transitions from the FNC to a program, choose only projects that are executed by contractors and that are a significant enhancement to an existing system such that they have it locked up and there is a large tail to bring it to fruition. This way they are incentivized to transition.

This observation represents a serious systems acquisition obstacle to our ability to introduce innovative new solutions and, ultimately, lower system acquisition and life cycle costs. Another respondent also commented that "the transitioning technology competes with or threatens an on-going activity that has an entrenched constituency." A further issue raised was the difficulty in fielding a technology solution in a timely manner. This, the military's equivalent metric for "time to market" in the

business world, is another area where the FNC Process aimed to improve. The comment made was:

> … I would guess the biggest obstacle is that, by the time the technology is ready to transfer, it is already seriously out of date. At the same time, as delivered, it is often poorly designed and executed (from a Human Factors perspective).

A final comment refers to difficulties as a result of a cumbersome acquisition process that has become consumed by cost and places the military in a position where there are no viable choices but to accept technology solutions for weapons system designs that are completely controlled by organizations that seek to maximize profits through marketing proprietary solutions:

> Two obstacles are (1) the difficulty in constructing a technology transition roadmap (i.e., identifying technology insertion opportunities for a platform or system), and (2) NIH; i.e., the difficulty in getting a contractor to transition a 'Navy' solution once matured.

The Navy's S&T community is outside the acquisition process and, as a consequence, has no means to directly affect transition opportunities that are controlled by these other organizations.

The responses to the question asking if there was agreement on project maturity, cost and schedule were mixed. Those respondents supporting the IPT through a Working Group or at the Project Level felt there were agreements on cost, maturity and schedule but members of the Principal IPT were not as confident; one representative felt there was good agreement (through the use of TTAs) but a second IPT representative felt there was not a general agreement (a third IPT respondent did not answer the question at all). These agreements are typically worked out at the Working Group and Project Levels so it is understandable that IPT support staff at these levels would feel confident they have worked out adequate agreements. It is a good indication that the IPT S&T support staff feed they have agreements in place (through TTAs or other mechanisms) but there is a disconnect on this question within the S&T community since the members

of the Principal IPT are not, apparently, as confident in those agreements as their support staff.

For the two questions that asked about collaboration efforts most respondents either chose not to answer the question or indicated they did not know. Two respondents were aware of products being funded through multiple IPTs and one respondent was aware of an FNC product that was a part of an ACTD and so had OSD funding. Another two other respondents, however, indicated they were not aware of any multi-agency funding.

c. IPT Process Questions

The question about the effectiveness of the IPT generated a mixed response. One respondent, at the Project level, felt the IPT was "adding a measure of what they were intended to" while another respondent, at the Working Group level, did not feel the IPT was effective ("No, too many changes in 'Leadership.'"). The IPT respondents were all over the board; one felt the IPT was effective, another did not know and the third did not answer the question.

When answering the question on how decisions are made within the IPT most of the respondents did not provide feedback data by either leaving the question blank (two IPTs, one "Other"), answering they 'Don't know' (Project level) or with a 'not applicable' reply ("Other"). For the two respondents who did provide feedback the IPT decision-making process involved a discussion within the IPT itself. The Working Group representative said the IPT decisions were made as the "OPNAV member decides with rest of IPT concurring" and the IPT representative responded that decisions were reached through a "Voting of primary members." These are not inconsistent observations since the IPT members approve investment decisions in a consensus manner in both cases. The question of how does the IPT make its decisions essentially reduces to one of an understanding of the role of the OPNAV member (as Chair of the IPT) and the nature and depth of the discussions among the IPT members. Most of those responding indicated that the project portfolio selection process was done in what appears to be a controlled and informal manner by the IPT. There is no formal process enforced across all IPTs and, as a result, the portfolio selection process is different for the various IPTs.

In general there was consensus that an S&T investment portfolio was prepared by the S&T representative, using a working group, and presented to the IPT for concurrence.

Respondents were split in their observations regarding whether or not a process exists for the selection of new programs. At the project level the input provided was:

> Not an official one that I am aware of. I think this is a really large problem with the FNCs as they have been locked up since the first programs were selected and thus do not have a viable way of introducing new concepts as need and execution changes.

At the Working Group level the survey participant felt there was a process which consisted of the working group ranking proposed new starts and submitting this ranking to the IPT for action. At the IPT level, however, there was conflicting inputs. One IPT respondent replied "Yes – sort of" while a second IPT respondent replied simply "No" and a third left the question unanswered.

Responses regarding the frequency of data calls were somewhat mixed. A number of respondents were involved in only a few IPT data calls during the previous year and the estimates they provided (of the number of data calls) differed enormously from the one participant (an IPT representative) who replied that data calls were frequent and a problem (37 separate data calls in the one case with the others being in the one-two range). The large variability is probably a function of the specific IPTs involved as well as to where the data calls are being directed. This implies that data calls are a significant and disruptive factor for the small group of people receiving the data calls, those doing the bulk of the FNC administration and management. For those outside of this small group data calls are not a major concern because they do not see them as they are filtered.

d. IPT Meeting Questions

Regarding the question asking if participants were kept informed of IPT meetings, the responses varied in accordance with the type of support provided to the IPT. Generally speaking those providing support at a lower level (at the "project" or "other" levels) did not feel they were being kept informed of IPT meetings while those providing support at a higher level ("working group" and "IPT" levels) did feel they were

being kept informed. These responses are consistent with previous input on how the IPT functions and supports the observation that the IPT is primarily supported by an S&T Working Group with this Working Group receiving input from personnel at the Project, and Other, support levels as necessary.

For the question asking if survey respondents ever attended IPT meetings the responses provided were consistent based on the support level and the resulting notifications provided. At the project level one of the responses was "No…I don't think I'm invited" while members at the working group and IPT levels indicated they had attended IPT meetings. One respondent, supporting the IPT in the "Other" category, indicated attending IPT meetings "infrequently."

Respondents indicated IPT meetings are held a couple of times a year with more frequent interaction being done via e-mail. Survey respondents also confirmed that all communities generally participated in the IPT meetings either "in person or by VTC."

e. Communication Questions

Although most of those responding felt they were being kept sufficiently informed of relevant S&T information, communication flow was identified in some of the responses as an area of concern. One respondent, at the Working Group level, mentioned having to search for information. Another respondent commented:

> This is a significant challenge in the S&T area. My lab is continually working to identify means of improving information flow. We are not, in my opinion, at a point where we can rest comfortably and say that we have achieved optimal communication.

When they do need FNC information respondents almost unanimously responded they went to ONR S&T representatives or the Program Manager for the needed information. It is interesting to note that only one respondent, serving the IPT in an "other" capacity, mentioned going to the S&T website for FNC information.

When asked if there was any information they needed but did not have, survey responses were equally divided between those who felt there was information they needed but did not have ("Yes, FY05 – FY09 ONR TOA $$") and those who thought they had sufficient information.

Survey responses indicate the Navy's S&T website has not been used to a great extent. Most respondents were aware of the website but indicated they have used it very infrequently. The infrequent website use appears to stem from the fact that users had found the data posted there to be outdated ("Not often, but I have used it. Information seems old."). One items of significance was that IPT members all indicated they had never used the S&T website at all. Such a response is consistent with the view of how the IPT operates; the members of the Principal IPT would not have any need for the S&T website since they would get their information directly from the Working Group members. Accordingly, membership below the Principal IPT level would seem to have the greatest need for the S&T website. In fact, however, survey responses indicated these members used the website infrequently because they also found the website to be an unreliable source of needed information.

The survey responses indicate the S&T website was not viewed as being useful to the S&T community. Consistent with other community website responses the S&T community Principal IPT members did not use the website and those respondents that did use the S&T website indicated the website was only marginally useful. Some of the typical criticisms of the website were that it was "too generic and old" and that it had "very limited; top-level info."

f. Satisfaction Questions

With the exception of one IPT representative, survey respondents from all categories were consistent in their mutual dissatisfaction of the FNC Process. One reason cited for the dissatisfaction related to the problems encountered when participants attempted to introduce new concepts into the S&T pipeline. With no established or known process to follow, no reliable visibility into IPT priorities and schedules, no consistent source of FNC policy guidance or assistance, and limited information availability the ability to influence the FNC Process seems extraordinarily difficult to anyone who is not an active member of the Working Group for each IPT. The end result is a cumbersome process that appears to broken. As one respondent commented, "[W]ithout a viable way to insert new concepts, the process seems broken. Also, the level of taxation is too high."

Although it might be too early to conduct a comprehensive assessment of the FNC Processes transition track record, there were a couple of areas cited by the participants as examples of areas where things seemed to have worked. The FNC Process concept was mentioned as being "a good one" by one respondent. This agrees with a remark made by another respondent to the effect that the FNC Process has provided a "better linkage between S&T and Acquisition." Another respondent also expressed satisfaction that technology demonstrations were still being funded under the FNC Process.

On the whole, however, most respondents were agreed in their assessment that the FNC Process itself was not working. A variety of shortfalls were offered, most dealing with "process" issues. One respondent suggested an essential metric for the success of the Navy's future naval capability process might be the ability to demonstrate an openness that allows for the introduction of new concepts and ideas into the DoN system. One of the comments made was that it was "[t]oo early to tell, but certainly the introduction of new programs is necessary if the FNC Process is to remain viable."

There were a couple of comments that attributed FNC Process shortfalls to basic process implementation issues such as poor communications, program (in)stability and dynamics ("Rules keep changing, ONR does not really support all FNCs"). As one respondent observed the FNC Process grew out of Navy resource planning between the VCNO, OPNAV and ONR and these changes were probably not widely understood in the early phases, even within the S&T community. Fundamental changes to the Navy's S&T Program (Program Element changes, etc) were made over time but, from the perspective of many affected by the changes, those changes may appear to have occurred "virtually overnight."

> The people I know in the labs are not sanguine that the process has been clearly articulated or properly executed. Furthermore, a non-trivial portion of the labs' work has been shut out due to lack of funding. Although I cannot speak for everyone, the entire FNC Process seemed to materialize virtually overnight and to starve many competing programs. This perception is, no doubt, at least in part a byproduct of a less-than-successful program of communication.

Another comment indirectly references the significant and practical interdependencies and programmatic difficulties encountered when the S&T community (BA1 – BA3) attempts to transition technical products to the warfighter through an acquisition process (BA4 +) they have no control over and which is risk adverse. Although the respondent doesn't elaborate, the comment briefly touches upon a few of the important issues with the FNC technology transition process: "Recognition of the interdependencies between FNCs and between multiple FNCs and PORs and how to address these."

An increased dialog with the acquisition community was cited by several respondents as the most important aspect of the FNC Process. Other important aspect was the Navy's obvious priority on addressing near-term fleet requirements with longer-term S&T resources. As might be expected, there are important implications for the Navy's research infrastructure when pursuing such a technology investment approach:

> The notion that the Navy is willing to focus its resources on its most important Fleet/Force requirements. At the same time, it is essential that all stakeholders in the Naval Research Enterprise clearly understand the importance of this undertaking and are onboard with the process as well.

In reviewing the feedback on the FNC Process, provided through the survey responses, it is not clear that the members of the Navy's research infrastructure, collectively referred to as the Naval Research Enterprise, understand their role and area of contribution in this new way of doing business within the DoN. As has been observed by some of the comments made by survey respondents there are many participants within the S&T community who appear to be confused and frustrated by the new technology transition process.

g. Additional Comments

The additional comments fell into three general groupings; comments on the lack of a technical Systems Engineering approach to the programs supported, comments on the management of the process itself and comments on the funding problems encountered within the FNC framework.

In the first grouping of comments, those with a systems engineering flavor, the FNC Process was criticized for failing to go far enough in its attempt to change how the Navy executes its S&T business. The attempt to transform Naval operations through the introduction of new and novel Navy capabilities are seen to have fallen short by the criticism that the "FNCs are, in effect, 12 new stovepipes." The suggestion the FNCs might be interpreted as new stovepipes is not entirely unexpected; the FNCs were designed to focus a significant percentage of Navy S&T resources on a smaller number of high-priority technology "thrust areas" which were derived from the Fleet CCIs and OPNAV inputs. So while the FNC might have created a different set of technology investment areas is not surprising the connotation of them being simply new "stovepipes" is a negative one, implying a number of disparate investment areas with little collaboration across FNCs or even within an FNC. A different comment also explores this issue by observing the projects funded within an FNC do not mutually support each other to reach critical mass for that desired naval capability, as was originally the intent. The observation that the FNCs have "no real system view, emphasis is just on FNC EC to one aspect of a single POR" implies the FNCs remain a bunch of individual projects attempting to deliver capabilities to specific programs of record with no obvious synergistic design or integration planning of the projects themselves. Very similar sentiments were expressed by a number of survey respondents. One respondent remarked there is no planning beyond the current PORs for what the FNCs should look like in the future and that there was no IPT "above the IPTs at the 12 FNC level" to provide guidance (although the TOG might be viewed as such an "overarching" IPT). The lack of "jointness" was commented on as well by the same respondent who felt the FNCs are not in line with the CNO's vision for Sea Power 21. A final comment by this respondent was an observed lack of interest in the FNC program on the part of the OPNAV and acquisition communities.

The second grouping of comments were of a 'process' nature. One respondent commented, "If you read the FNC documentation, the process is a good one. In reality, though, ONR, N-091, TOG, etc., etc., keep pulling up the tree to check the roots." Another respondent suggested the FNC Process has been mismanaged by the

Navy: “ONR leadership has failed the FNC Process. Witness the turnover in S&T leads. Instead of being held in high esteem by ONR, FNCs appear to be an obstacle to CNR’s plans.” The essence of this remark is a thread that runs through many of the surveys and interviews. It is difficult to come up with an exact figure but personnel turnover within S&T and the FNC infrastructure has been extraordinarily high. Where this type of turnover might be viewed positively (wring out the old, inject new blood into the system) it can also be seen in a negative light (loss of corporate memory, experience and project continuity).

The question of accountability was raised in a comment made by another respondent: “Have any of the FNC’s been judged to have failed and been terminated or had their “Board of Directors” replaced?” This is an important criticism. Although there has been a barrage of reviews conducted over the (short) life of the FNC Process there have been no assessments of “failure” levied against any of the FNC’s. Two of the FNC’s (Capable Manpower and Warfighter Protection) have been repeatedly targeted for serious funding reductions and eventual termination but such targeting has been due to a lack of requirements rather than a failure of the IPT or the technical projects themselves. In fact the reason these IPTs survive such reductions is probably due to the constituent communities that were too unified to allow significant reductions to be imposed.

The third grouping of comments dealt with funding issues. Funding has been raised as an area of concern among all stakeholders. With reference to a seemingly endless round of internal and external programmatic reviews, and the funding perturbations that might reasonably follow such reviews, one of the respondents made a blunt request for Navy management to reduce the level of oversight and the programmatic disruptions which invariably results from such intense bureaucratic oversight: “Stabilize the funding & stop reviewing us all the time. Give us time to do some of the work!”

The impact volatile funding levels had on program management was a common theme in responses. The difficulties caused by the funding turmoil was especially evident in light of the tremendous effort imparted to garner formal transition agreements with acquisition program managers for projects being funding with S&T

resources. Each round of funding reductions could reasonably mandate a renegotiation of transition agreements already agreed to as well as jeopardize those agreements being negotiated. The atmosphere created becomes one of increased technical uncertainty and programmatic risk; attributes not welcomed by acquisition program managers who are inherently risk-adverse. The resultant effect of this instability was:

> Funding instability AND requirements for signed TTAs has left a bad taste in the mouths of our customers. We've had to renege on TTAs we've signed.

Typically S&T level of investment is low when compared to any major acquisition program. The funding instability issue mentioned, if left uncontrolled, causes several problems. One, for the acquisition community, is that it jeopardizes a much larger pool of acquisition resources. A second consequence is that it forces the acquisition manager to either develop alternative technical solutions or to demote the technical solution being developed to a lower priority naval capability (one that has little of no impact if not developed on time). This, in effect, characterizes the Navy's S&T investment to one of almost technical irrelevance. A third consequence is one of a lack of credibility due to an ability by the S&T community to live up to negotiated agreements, such as was stated above. This funding instability has very serious ramifications for the transition process because it undermines the sense of trust among the transition partners and fosters a perception that the S&T negotiators have no credibility to back up future agreements. If not resolved, continued funding instability problems might very well undermine the results the FNC Process hopes to achieve; transition technology to the warfighter. If formal transition agreements (TTAs) are the primary vehicle through which new and innovative technology is transitioned to the warfighter but these transition agreements can't be agreed upon because of perceived S&T funding instability issues then it is reasonable to presume the number of transition agreements would go down and, as a result, the number of transitions would become fewer. The logic sounds circular but illustrates the cause and effect nature of the transition agreements and the FNC transition metric itself. There is no doubt that other factors (from an S&T perspective as well as from the requirements or acquisition

perspectives) that will also affect the Navy's ability to transition new technology to the warfighter but funding will be an important one to control.

h. S&T Community Analysis Summary

The survey respondents included at least one representative from each of the four basic support categories (Principal IPT, Working Group, Project Level, and Other). Of particular interest was an examination of the responses to the questions by representatives of the different support categories. In examining the responses it was observed that each question generally received a number of "not applicable," "do not know" or the responder did not provide a response at all. A higher than expected number of "no response" answers are attributed to a survey, from an Principal IPT representative, that was returned with only a few of the survey questions answered.

With one possible exception, the survey responses were found to be reasonable and consistent. The responses provided are reasonable for the indicated level of support provided to the IPT. Collectively, the respondents also provide a consistent picture of IPT dynamics within the various IPT support groups. The possible exception refers to response ST-7 where the level of support is indicated as being at the IPT level and the Project Level. Some of the responses from this respondent appear to be inconsistent for an IPT representative and seem to be more in line with representatives supporting the IPT at the Project Level. It is possible the survey responses from this individual are a complicated mix of observations formed through supporting the IPT in several ways. For the purposes of this survey the responses of ST-7 seem consistent with others if taken as input from a participant at the Project Level.

3. Acquisition Community Responses

Survey responses were received from representatives that supported the FNC Process in all stakeholder categories. Representatives at the Working Group level were the most frequent but responses were received from representatives of the Principal IPT,

at the Project level and those that supported the IPT in an "Other" capacity as well. The survey response ratio (surveys returned/requested) for the acquisition community was 53.9%.[221]

a. General Questions

Most respondents felt the "customers" for the FNC Process were the Program Managers for current acquisition programs. Respondents acknowledged the warfighter as the ultimate customer, as the end user of the products developed, but nevertheless felt the FNC Process was targeting meeting the needs of acquisition programs. As one respondent commented:

> The eventual user of the technology is the Sailor and Marine. However, the most immediate customers are the PARMs [sic] and the Major Acquisition Program Managers.

Although similar comments were made by others as well the question of who, specifically, is the customer of the Navy's FNC Process was not as clear to other respondents. Another respondent commented:

> Good Question. I could speculate as to who it is but it is not clear from my involvement as to who the process framers believe is the customer.

Another respondent appears to have some difficulty pinpointing a specific customer and expressed the opinion that the FNC Process was really targeting the Navy's Headquarters Command, OPNAV, as the customer:

> Hard to say. It seems like OPNAV is who is being appeased through the IPT. But it's the Acq[uisition] PM's who deliver the capability to the fleet and it's the fleet who are the end-item users.

Clearly there are divergent views, and questions, with respect to "who" within the DoN the FNC Process is serving. This last comment is in line with the viewpoint that the FNC IPTs build programs in response to identified naval requirements. The OPNAV community provides the financial resources for the products developed but

[221] For the Acquisition Community, there were 13 survey requests made and 7 surveys were returned. Requests were made to Navy and Marine Corps members (military and civilian) of FNC IPT members and FNC working group support members. Survey requests were made from just over one-half of the FNC community and the survey responses received covered roughly one-third of the FNC community.

it is the acquisition community (PEO's and their PM's) are responsible to manage and deliver these products to the warfighting community.

All respondents were in agreement that the goals and objectives of the FNC program were explained within the acquisition community. Even though there was good agreement in this regard there were some important issues raised. One issue, a recurring one through the survey responses, was the lack of open dialog on how new thoughts, ideas and programs would be pursued and introduced into the FNC Process. As one respondent remarked:

> Early on (98) the theory was described. Questions such as "how do new projects begin?" were deferred.

Other respondents questioned the consistency ("Yes, but the explanation has not been consistent either over time or by presenter") as well as the penetration of the message throughout the acquisition community ("Numerous times, but I'm not sure everyone was ever contacted").

Responses to the question asking about the impact the FNC Process has had within the acquisition community were mixed with the overall consensus seeming to be that the net impact has been only modest at best. As one respondent has observed:

> Some initial modest improvement in OPNAV participation (in FNC Chair role). Some increased communication between PMAs and ONR FNC PMs. In both cases, improvement has seemed to fade as people have turned over.

Another participant conveys two aspects of the FNC Process; a positive one where S&T investments were directed toward fleet priorities that had not been typically addressed by the S&T community and a second, negative, aspect where the FNC Process seemed to get quickly bogged down in a series of numerous program reviews, process changes and funding cuts:

> Two main impacts. One increased hope in that more funding has filtered to items or people that normally have not benefited from ONR investments. Second extreme frustration at the continued reviews, changes in scope, budget cuts, taxes and other issues that take all of the efforts and through it away before resulting in a product. This impact is

> amplified when most of the efforts put forward in the early stages were completed without funding based on the future benefit that in many cases will not materialize.

Another respondent views the FNCs as an improvement over the Navy's previous technology transition process, the ATDs:

> Better continuity, less of a "food fight" for ATDs that didn't necessarily connect to programs.

There was a variety of manners in which respondents mentioned they engaged the FNC Process. Most appeared to engage the FNCs through such means as acquisition members of the IPTs (There are acquisition representatives as members of some of the FNCs and periodically Major Acquisition Program team members meet with FNC membership"), SYSCOM technology review boards and key ONR contacts. Some responses seem to indicate dialog problems exist but did not elaborate further ("Through ONR PMs, but with much difficulty"). Another respondent, supporting an FNC at the IPT Working Group level, provided greater insight into the nature and type of interface problems that may commonly exist within the FNC Process:

> It has varied throughout the process. At times – especially in the beginning – we were very organized with a centralized representative for our community within our FNC. As the process evolved and people changed, it has ping-ponged back and forth and sometimes both at the same time between project level direct engagement and formalized centralized organization engagement. More specifically – often there is direct engagement from the ONR program management with the acquisition representatives on an individual effort and other times the ONR-NAVAIR contact is brokered through a single individual who coordinates a NAVAIR response. The problem has been assessing when which method is correct and lead to either issues of mistrust (centralized communications) or misunderstanding of command priorities (direct project level communications).

Although some respondents clearly see the FNC Process as being important to the acquisition community most responded in a lukewarm manner when asked about the important of the FNC Process. One comment suggests the importance and impact of the FNC Process has been reduced because of the manner in which it is being implemented. Even though the goals and objectives may have been articulated

within the acquisition community, if these goals and objectives are not synergetic, or if they are not well understood, the results will be less than optimal. If the process questions and issues are not resolved the process devolves to one that is merely "endured." As one respondent commented:

> To my community the FNCs are extremely important since there is no other source of S&T investment for my community. The specific question of how important is the process is somewhat different in that the process does not appear to be clearly defined and articulate and as such is not understood. The result is the process is something that we endure to ensure that we can continue to maintain even the smallest of S&T investments in cost reduction and sustainment technologies.

This comment suggests the importance of the FNC Process stems from the fact that the FNCs represent an important source of Navy investment resources to reduce risks and lower costs for delivering improved capabilities to the fleet. This assessment is consistent with a comment made by another respondent:

> On a day to day basis not very important. However, on a long term basis it is one of the few places where new technology is being developed to an acceptable level of risk for insertion into acquisition programs.

Another respondent more succinctly links the importance of the FNC Process to being the primary source of revenue within the NRE for technology development purposes. The Navy's S&T Program has responsibility to manage and support the technology development efforts throughout the DoN community. Over the past several years while S&T accounts in other agencies have been going dramatically up an opposite trend has been true, for a variety of reasons, within the DoN. Frustration over this shrinking pool of resources within the NRE community is expressed by this respondent:

> Importance lies in the flow of money to conduct S&T. For whatever reason, S&T funds are in decline and nowhere more than at the warfare centers. FNC managers seem to be directing funding away from NAWC.

Another respondent's comment briefly touches upon the thorny issue of who has "control" over the S&T resources. The issue of control is a common thread that appears throughout the interviews and surveys – the question regarding who has (and

should have) ultimate control over the direction and use of the Navy's S&T resources is central to the problem of transitioning technology. As one respondent remarked:

> Critical to some, barely understood or appreciated by others – still others regard FNC funding as money that should be theirs, but they can't direct it… that's not necessarily a bad thing.

The issue of "control" has been a problem before the FNC Process and will continue to be a problem after the FNC Process has been superceded by some other later process. More to the point is that for real progress to be made the Navy's S&T Program, and its technology development process, needs to be clearly articulated, understood and agreed upon by all stakeholder communities within the DoN.

b. Transition Questions

Respondents were mixed with respect to their confidence as to whether programs would transition as planned. Some respondents were confident about transitions they had control over:

> I am confident that most if not all projects that I am involved with will transition successfully provided the S&T produces the intended results. I am so confident that I have budgeted most transition efforts directly into my RDT&E line.

The lack of confidence was attributed to a lack of confidence in maintaining adequate funding to complete the technology development effort:

> Some will transition, probably not as planned (schedule-wise). Many will never transition due to repeated funding cuts by ONR.

The use of transition agreements provides a higher degree of confidence due to the interaction and dialog necessary to get the agreements signed. As is mentioned, if this dialog is diminished the confidence in the transitions is diminished as well:

> In the case of signed TTAs, confidence is higher. Lack of regular and ongoing comm's puts even these agreements at risk.

Without exception, survey respondents agreed that FNC programs are being transitioned to current acquisition programs of record. The awareness and use of metrics for transition was, however, less clear. The metric most frequently cited was a

generally vague one of “transition” (via signed technology transition agreements, TTAs) without a more complete description of what such a metric might actually mean. Other metrics mentioned were the use of a 6.4 PE, NASA technology readiness levels (as an estimate of technical maturity) and warfighting value. Some IPTs have made an attempt at trying to identify useful metrics. As one example:

> Return on investment and successful transitions. ROI is for project prioritization and performed by NCCA. Transition is a measure of success of the projects themselves.

The identification and use of meaningful technology transition metrics is a difficult problem for all of the FNCs. The current approach relies primarily on the use of TTAs with the acquisition program managers. While this approach is useful it drastically limits the potential market for the technology development effort without being able to guarantee the transitions will occur as planned. Most troubling is that the difficult and important issues regarding transitions are not being widely discussed among the Navy’s stakeholder communities. Whether intentional or not the whole ‘transition’ problem seems to have been suppressed, possibly because the problem is such a difficult one and no community wishes to make the compromises that would be necessary to resolve it. As one respondent has observed:

> This has never been well explained (or consistent across all FNCs). TTAs should not be the only measure.

There were two primary obstacles mentioned by survey respondents in relation to problems in transitioning technology as planned; our acquisition process and funding instability. It is significant to note the acquisition community itself recognizes some of the serious shortfalls inherent in our current acquisition process.

The use of NASA’s Technology Readiness Level (TRL) assessments were introduced into the FNC Process as an already-proven useful metric of relative technology maturity. The practical problem in doing so, however, has been that when such maturity assessments are applied to whole programs at the IPT level the wide latitude used in making such assessments make the maturity assessments meaningless. As one participant commented:

> The state of the technology is not at the maturity level desired to sufficiently reduce risk and the DoD budgeting process does not allow major programs to budget for emergent technology insertion into programs. Additionally prime systems integrators have little incentive to use new technology that does not increase their profits.

Funding problems (insufficient or unstable) were mentioned in a number of returned surveys as a major problem. One respondent remarked there have been "Seemingly constant funding level changes. There is little stability." Another respondent expressed a similar observation with additional emphasis:

> 1. Funding. 2. Funding. 3. Funding. More specifically: 1. ensuring transition funding is in place. 2. preserving FNC funding in light of all of the cuts and taxes to produce the technology sound product on the timeline promised. 3. Convincing the powers that be that a spec or manual change is a viable transition path that does not require a funded budget line and that the project should not be canceled due to weak transition agreement.

Difficulties with the Defense Department's acquisition process were mentioned, too. The current cumbersome and convoluted military requirements generation process and how it is (or is not) integrated into a coherent Navy headquarters (OPNAV) resource budgeting and program acquisition strategy was alluded to in brief comments ("Today's requirement/budget process") as an obstacle as was the general lack of efficient and effective communication among those very same stakeholder communities ("As before, lack of comms with transition sponsor"). This communication problem is another that surfaces throughout the surveys and interviews. The net result is that program advocates seek out requirements from any of a myriad number of (valid) communities for their program. The effort to obtain an endorsement (what that may mean may vary) becomes a marketing job and drives the technologist to be overly optimistic in program abilities and unrealistically conservative in estimating development schedules, cost and performance. Since there are no costs or metrics or accountability there is no problem with this approach since you are playing with someone else's money. As one respondent has experienced:

> Underestimating the expense and scope of development required to reach program office expectations combined with overestimation by program offices of maturity of what will be delivered.

These types of transition obstacles continue to exist throughout DoN because program expectations are not discussed in depth at significant levels among the stakeholder communities. As a result of this communication shortfall there exists a lack of understanding of the enormous issues, and consequences, involved. This, too, is not the problem of only one community but is equally a problem of all involved.

In general, acquisition community survey respondents thought there were agreements in place for project maturity, cost and schedule. This is understandable since the majority of these agreements were reached as a necessary condition for the approval of required TTAs and many of these same acquisition personnel were involved in the brokering of these transition agreements. Even so, when sampling across the acquisition representatives there was not unanimous agreement for maturity, cost and schedule. For example, as one respondent has observed, "My view is that some of this exists but on a case by case basis" while another remarked "Sometimes but frequently not." These observations imply the agreements are less pervasive, or less stringent, than one might be led to believe at first glance. The tendency to be overly optimistic in program planning is again seen in the observation of yet another participant:

> Generally, though that agreement is frequently based upon "success oriented" projections.

The questions that asked if any of the IPT products were funded by multiple IPTs or by joint Services or Agencies (i.e., AF, Army, DARPA, etc.) generated a mixed response. For both questions some respondents thought there was multiple and/or joint investments but a roughly equal number did not think so, were unaware of any, or simply indicated they did not know. One respondent, however, was able to provide some details for an instance where there is some evidence of program integration among separate IPTs:

> Yes, for instance anti torpedo torpedo relies on a weapon and passive sensor being developed by F/FP and an active sensor being developed by LASW.

Regarding pursuing funding from multiple IPTs, another respondent recounts the FNC programs' early emphasis on cross-FNC collaborations that were not fully realized due, again in part, to funding shortfall and stability challenges experienced by all of the FNCs:

> There seemed to be some initial cases of this but the recurring budget cuts seems to have forced them into one FNC or another.

A similar observation is mentioned by another respondent as well:

> Not that I am aware of although we did attempt to get a project funded via multiple IPTs. The other IPTs did not either care to pursue this route or have the funding to spare to do so.

The focus on a "lack of funding" is an easy crutch to use but the data does not come close to supporting such a narrow view of the events. The FNC's were envisioned as a "new way of doing business," one that would focus one half of the Navy's S&T budget on addressing the highest priority challenges and technical issues of the Navy. The program started out with a $750M budget which was gradually reduced by 1/3, to the approximate $500M level (still a significant investment). The lack of a cross-FNC collaboration emphasis should not be confused with, or blamed on, a funding deficiency but should be recognized as endemic to the IPT's approach to implementing the FNC Process – maintaining S&T resources for a small naval community at all costs. Viewed in this manner funding might be simply a convenient excuse to not do something the IPT does not have a desire to do. Unless there is an obvious benefit for one IPT to support the capabilities of another IPT there will not be any collaboration. This approach is not consistent with the "joint" emphasis being pursued at the DoD level but is reflected in the observations of the survey respondents. Although there were two exceptions most respondents reported they were not aware of any jointly funded IPT programs. As one participant remarked:

> No program that I know about. Some programs have joint funds but only because it's mandated. Nothing's joint by choice (look at the Navy interest in ACTDs – nil).

This comment is contrasted by that of another respondent who noted that the KSA FNC "has an ACTD" as well as a remark made by a different participant: In our FNC we have at least one project that is receiving funding from both the AF and the FAA.

Conflicting comments such as these are an indication of the low level of awareness and collaboration among the IPTs regarding what they are each doing. This lack of awareness tends to lend credence to the earlier criticisms of "stovepipes" across the FNCs, a criticism of the earlier ATD program as well. Furthermore, it seems that even when the IPT develops products that will likely have known joint utility there is evidence of little collaboration. Providing an example of such a case a respondent commented:

> Not aware, though some products, like an improved ALE 50 towed decoy, will likely be used by Air Force as well as Navy planes.

There may be numerous reasons for deciding not to pursue joint funding but such an approach runs counter to the trends, guidance and direction being disseminated by the DoD over the years. For whatever reasons, the FNC Process has not been able to effectively engage in a significant number of collaborative projects either within the DoN (cross-FNC) or within DoD (joint Service or Agency). The Navy's participation within the ACTD process, mentioned numerous times, is one possible metric in this regard. An investigation into the issues encountered when involved in a joint program is beyond the scope of this thesis but should be explored.

c. IPT Process Questions

Respondents were mixed in their assessment of the IPTs effectiveness. This varied mixture is undoubtedly a reflection of the differences among the individual IPTs and their support teams. Recognizing the IPTs operated differently, there were those who offered a more positive assessment of the IPT. As one participant has observed:

> Largely. My perception is that it varies. Some seem to play very even handedly, while others seem to have been hijacked by the community to which the chairman belongs.

In other cases, although respondents provided a more negative assessment of how the IPT manages its investment portfolio, there was still the feeling that the FNC Process, flawed as it is, is better than the transition process that preceded it:[222]

> Short answer is NOT VERY. But must be considered against what the alternative would have been. Pre-FNC approach would have suffered even more from the continuing reduction of budgets.

Responses to the question asking for information on how decisions are made by the IPT indicate the IPT members discuss options but the final decision is made by the Chair ("By the chair after considering all points"). Another respondent, supporting the IPT at the Working Group level, has observed that the decisions are "generally worked out at a senior manager level, then ratified by the IPT." Further insight into the IPTs ratification process would be helpful to an understanding of IPT dynamics. The consensus-based approach of typical IPTs can easily devolve to a 'design-by-committee' approach that hinders creativity and innovation and encourages nominal performance so long as everyone involved in the decision gets something for their community from it. Hints of this approach are evident within the remark, "Flag-level tradeoffs. The Chair makes the IPT decision."

Respondents were in general agreement that the personnel turnover rate within their IPTs has been high. As an example, one respondent mentioned the IPT's acquisition representative was already on their third IPT member. Comments such as "My observation is all too often" and "Lots. There's always someone new," although not specific, indicate a highly volatile membership and team dynamics. The military emphasis and component of the IPT, of course, contributes to the membership turnover rate due to the rotational nature of their billets. Such an organizational structure lacks continuity and places an increased emphasis and reliance on the part of the Chair, as the decision-maker. A high turnover within the Chair position, which sometimes occurs as evident by the remark "Chair alone has changed 6 times in 3 years," becomes a more damaging and disruptive situation for the IPT to contend with.

[222] For the Navy, the process that preceded the FNC process was called the ATD process. The ATD process is still used by other Services.

From participant responses it appears the IPT portfolio selection process is essentially a closed-community and fairly subjective one. Those involved confirm that each IPT runs its own selection process since there is no uniform process enforced for all. This type of approach tends to present a fractured appearance as indicated by one observers remarks, "From the outside, each FNC has a different, subjective method."

While some indicated they were not knowledgeable about the IPT portfolio selection process (i.e., "Don't know") others indicated the selection process consisted of IPT support staff preparing the S&T program and presenting to the IPT for approval ("ONR proposes changes to flags & executes"). This type of process is supported by another respondent, supporting the IPT at the Working Group level, who participated in the portfolio creation process:

> A relative ranking based on warfighting contributions, technical likelihood of success, and fiscal restraints.

This indicates that an IPT S&T strategy is attempted at the Working Group level. Additional information would be needed to understand the dynamics at the IPT level when deciding which programs get approved and for what reasons. A comment submitted by another respondent implies the final IPT decisions involve a compromise among the stakeholder communities involved with that IPT:

> ONR submits a program and the IPT approves the program. As long as there's something there for everyone it's usually ok'd.

Clearly not everyone is happy with how the program selection process is managed by the IPT. As another participant comments:

> If this means projects, initial selection was a process that I was a part of but would rather not discuss. Cuts are implemented from the bottom of the prioritized project list based on return on investment.

This statement appears to be two separate comments run together. The first ("If this means projects, initial selection was a process that I was a part of but would rather not discuss") appears to express the participant's frustration with the initial selection process as the FNC's were being established. The second comment, however ("Cuts are implemented from the bottom of the prioritized project list based on return on

investment"), indicates that some of the IPTs, at least, do have a process for the cancellation of programs that fail to meet some type of metric.

In answering the question regarding whether or not there is a process for the selection of new programs, some of the respondents indicated there was. In particular, the KSA FNC was singled out for having a new program process. Another respondent referenced an apparent relatively recent change to an IPT that brought about a process for selecting new programs. In answering the question this respondent commented:

> Yes, but that has largely developed since I have become distanced from the process.

Looking at the responses to this question from the various IPT support levels might be useful. One participant, serving as a member of the Principal IPT, indicates the new program selection process is handled through a "group discussion" at the IPT level. A second participant, serving as a support team member at the Working Group level, commented "one is currently in development but none exist today." A third respondent, serving the IPT at the project level, remarked:

> If there is, I have not heard of it other than the prospect of replacing a terminated project—which possibility seems to have been overtaken by budget cuts before a new project could be started. None that I have ever heard about.

These observations, although not intended to imply a direct reflection of any specific IPT, do seem to be consistent with the emerging view that the new program selection process across the FNC IPTs, as a whole, has not been implemented or widely articulated. These observations, by participants actually involved in the process, seem to indicate that the investment decisions within an IPT are made rather informally through consensus-based discussions among IPT members. Since the bulk of the IPT programmatic "work" is done by the support staff at the Working Group level it is understandable that participants at this level are working out the details of a more formal selection process but this remains a work-in-progress. At a lower level of support, at the technical project level, these efforts are not readily apparent. Staff supporting the IPT at

the Project Level are removed from the decision process and cannot easily gain insight into how IPT investment decisions are made.

The question about the number of data calls the participants were involved with over the past year is also interesting when the responses from the various IPT support groups are examined. At the IPT level the response was “many, many, many” while at the Working Group level the responses from two different participants were “Me, none, the IPT, many” and “One or two. It has either slowed down or I have been pushed farther out of the loop.” At the Project Level the responder felt the question was not applicable (“N/A”). These responses indicate the data calls were targeted primarily at the IPT members who may have drawn support from the various Working Groups as necessary. It appears that data calls did not reach the support staff at the Project Level on a widespread basis.

d. IPT Meeting Questions

This group of questions was written to draw insight into the manner in which the IPT meetings were conducted as well as an attempt to determine how closely the various support groups were engaged with their IPT. The first question asks if the respondents are even informed of the IPT meetings, for a starting point. Responses indicate that invitations to the IPT meetings are made at the Working Group level but are not generally passed down to the lower levels of support (Project Level and Other). The Principal IPT representative reports receiving invitations as do the representatives at the Working Group level. At the project level the respondent replied, “Not formally—word of mouth at best.” At the “Other” level of support the replies were “No” and “Seldom.”

For the question that asked if our respondents have ever actually attended an IPT meeting the replies returned were a unanimous “Yes” indicating that at some point in the FNC Process all survey respondents were engaged with the IPT to some degree.

Responses to the question asking about the frequency of IPT meetings, the responses indicated IPT meetings were occurring on an approximate quarterly basis. Respondents at the IPT and Working Group level indicated quarterly meetings while respondents at the lower levels of support (Project and Other) felt the question was not applicable to them or, as in one case, replied “semi-annually.” Once again, the fact that

the lower levels of support do not know the meeting frequency for the IPT indicates they are not being engaged in these deliberations.

Respondents reported mixed observations regarding whether or not all stakeholder communities were attending IPT meetings. Although the Principal IPT representative responded that all communities were represented ("Yes, or their rep[resentative]s"), such a response does not necessarily mean representatives from each of the stakeholder communities actually did attend the IPT meetings. Responses from most other responders seem to differ in this assessment and indicate attendees were primarily OPNAV and ONR with the fleet representatives not typically being present. As one respondent at the Working Group level commented, the IPT meetings were "frequently missing fleet representation."

e. Communication Questions

The communication questions were designed to provide some insight into the amount and quality of information exchange that was going on within the IPT and its support staffs. The first question asks whether or not the participant has been kept informed of relevant S&T information. The response, across the spectrum of responders, was largely "No." There were two possible exceptions within the acquisition community; one from the IPT representative and the other from one of the three Working Group representative responders. All other responders indicated they were not being kept adequately informed. One participant observed "New information is not pushed out very aggressively" and another focused on my "relevant" qualifier, suggesting that the IPT sends what they think is needed rather than what may be needed:

> Relevant is the key word and in the eye of the sender. They believe I am.
> I do not believe I am.

In response to the question asking where participants go to get any needed FNC information, most survey respondents said they went to the S&T representatives and trusted agents. This feedback reinforces the view, presented earlier, that the S&T investment portfolio is prepared by the Working Group and presented to the IPT for concurrence and approval. It is significant to note that the two exceptions to these comments were both from the "Other" IPT support category and in both cases the use of

the S&T website was cited as a major (in not primary) source of FNC information. The utility and usage of the FNC website is commented on elsewhere but, suffice it to say, the FNC website is not considered to be an extremely reliable or accurate source for FNC information at this time. One possible explanation for the use of the S&T website by the "Other" IPT support staff would be one of necessity due to a remote location: they use it because it is all they have ready access to. Of course it is possible that for their IPT the information at the S&T website is fairly accurate or that the information they require in of a more generic nature.

In response to the question asking if there was any information the participants felt they needed but did not have, the replies were mostly "yes." The two exceptions to this question, once again, were from the IPT representative and from one of the three Working Group support team members. All other survey respondents mentioned information they would have liked to have but were not able to get. Some information seems so fundamental to the FNC Process that its absence is astonishing. To cite a few examples, some of the items the respondents had difficulty in obtaining included transition agreements, recent briefings, new IPT Enabling Capability descriptions and "new desired program directions." The fact that these items were not easily obtainable indicates a communication problem, workload overload or a lack of willingness to respond to the requests. Whichever is correct the lack of response to such fundamental information requests generates an impression that the process is flawed and unfair. One respondent remarked on a desire to have access to IPT financial information:

> [I] would love to have a current program of record. Financial data is always hard to get and expect it will be near impossible now that N911 is no longer part of the IPT.

This latest remark refers to the past role of OPNAV N911 as the Executive Secretary for each of the IPTs. In this capacity N911 would prepare and make available a POR for the entire FNC Program. Although this POR was never completely reconciled with the ONR records it did provide an accurate "snap-shot" of the S&T investments from the Resource Sponsor perspective and provided a point of reference from which stakeholders could obtain an estimate of the intended DoN S&T investments in any

particular thrust area. Over the past year organizational changes within OPNAV have eliminated the N911 office and many of the Resource Sponsor duties appear to have migrated to OPNAV N70.

The responses to the question asking how frequently participants have used the DoN S&T website indicate the website is not widely used. The implied infrequent usage is consistent with the website usage data provided earlier. At the IPT level the website was used “rarely” while at the Working Group two respondents indicated “never” and the third did not know. At the Project level the respondent remarked, “Never, anymore. After numerous initial attempts, found there was almost no info posted.” Again the two exceptions were those that were supporting the IPT at the “Other” level. In these cases the website was used “very often” and “at least once a week.”

When assessing the S&T websites usefulness respondents did not rate it very high. Most users appear to have tried using the website but then found the data to be out of date, unreliable, and not helpful. At the Working Group level one respondent commented the websites’ usefulness was “Unknown. It was always so badly out of date that I stopped using it.” Another respondent, also at the Working Group level, felt the data there is “Useless. Info[rmation] is old and unreliable. I have to double-check anything there that matters.” These sentiments correlate with another comment made (at the Project level of support) regarding its usefulness, “Somewhat useful at the beginning, but that info has never been updated.” Even the respondents of the “Other” support category gave the S&T website a lukewarm assessment. One respondent commented, “It’s OK. Often all we can get” and the other remarked “The latency of the information does not make it very useful.” From a section of the acquisition community that is actually trying to use the S&T website as intended these assessments indicate an area that needs improvement.

In response to the final question of this section, how frequent is the interaction with the S&T FNC representatives, the answers indicate there is a good deal of interaction. The IPT representative response indicates a close working dialog with the S&T representative; they interact on a weekly basis. At the Working Group level two of

the respondents reported meeting with the S&T representatives a couple of times a month. The response of another Working Group participant indicates there is some friction between the acquisition and S&T communities. In this case the interaction was described as such:

> When they want something that they can only get from me. When I want something I can only get from them. Otherwise we avoid each other.

The interaction, of course, may be affected by other factors. The interaction might vary considerably by IPT (as already indicated some IPTs are more "open" than others) as well as be personality-dependent. Some of this dynamic is reflected in another comment made:

> Depends on the FNC. KSA: once every 3 months; FFP: once a month (more frequently with POM06 process); ACES: once to twice a month.

f. Degree of Satisfaction

The overall level of satisfaction expressed by the survey respondents was decidedly mixed. As might be expected the IPT represented was satisfied. Other participants, however, had somewhat different assessments. Two respondents were satisfied with one of them commenting that the FNC Process was "Far better than what existed before." Another respondent gave the process a mediocre rating ("On a scale of 1 to 10 it is a 5") while the other respondents simply answered the question "No."

A number of things were mentioned by respondents when asked for examples of what has worked in the FNC Process. Comments provided indicated there is a sense of a greater unification within the Navy as well as simply the accomplishment of "getting stakeholders together." Another comment made was that the FNC Process has forced a "Consolidation of focus areas to allow meaningful accomplishments" which is very much in line with the original intent of the FNC approach.

A number of things were also mentioned when asked about what has not worked for the FNC Process. The most frequent item mentioned was inadequate funding. Other items mentioned included a lack of effective communications/teamwork and a continuing tendency to pursue technologies in a "stovepipe" manner. With respect to the funding issue, one respondent commented, "Funding has not been stable nor of the

amount originally planned when the FNC Process was started." This response was consistent with other responses as well ("Constant cutting of FNC budget" and "Fencing the FNC accounts from cuts (even discretionary ones)"). The remark made about the lack of communication and teamwork was:

> Teamwork and communication. We continue to function with an us and them mentality. Believe that the IPT is viewed as an impediment that is only there to dilute ONR authority.

Finally, another participant suggests the Navy's FNC Process has not been able to break down some of the traditional barriers that have been carried along from the 'old way of doing business.' The comment made was:

> It's still a 'good old boy' network with the old stovepipes. Not much has changed wrt [with respect to] getting things out the door faster. The case for the usefulness of S&T to the warfighter has not been effectively made.

The reference to "stovepipes" is made by several different individuals at different times and implies that much has not changed. The two other remarks are probably more significant, however. The reference to "getting things out the door faster" is actually a fundamental metric of the FNC Process. The FNC Process focuses on delivering new capabilities and products to the warfighter over the FYDP (rather than over a longer-term) so that S&T products will in fact go "out the door faster." If "not much" has changed, as the respondent believes, than the FNC Process would indeed be viewed as a failure. The other remark, that the case for the usefulness of S&T to the warfighter has not been made, is another fundamental issue and might possibly be the root cause for the changes to the S&T Program to begin with.

According to respondents the most important aspect of the FNC Process lies in the collaboration and program planning the process requires. As one respondent commented, the importance was "Enforced planning and collaboration between FNC, acquisition program offices and acquisition sponsors." Another participant suggested the importance was in having "a formal process to examine and plan for future technology needs. Without this, S&T investment would be chaos." This remark resonates with a comment made by yet another respondent:

> It should be that all communities have a voice so that we can ensure that the S&T investment is focused in areas that will best benefit the Sailors and ensure that the transition follows the S$T [sic] investment in a timely manner. It should also be that it allows for more secure budgets of both the S&T investment and also the transition funding but I have yet to see that happen.

g. Additional Comments

Successfully developing a new technology, a new warfighting capability, and transitioning this new capability to the warfighter in a rapid and timely manner is at the core of the DoN FNC Process. To accomplish this goal the Navy needs the right people doing the right job. Even then, it is extremely difficult. One of the comments made by a respondent suggests we might not have our teaming correct:

> Technology transition is not an easy business and frankly does not appeal to the personality of many outstanding research scientists. I believe it would enhance each of the FNCs if they had a transition advocate to help facilitate the "marketing" and identification of potential applications for the various technologies in development by the FNCs.

The specific issue raised here mentions a possible need for “marketing” the FNCs through the use of a transition advocate. There is no doubt that such an advocate is essential to any successful project but the more general issue raised here seems to be whether or not research personnel are the most appropriate people to be charged with transitioning technologies to the fleet. The argument would be that researchers will not necessarily have the most appropriate skill set needed since the variety of skills required to develop, test and produce a product are different for each phase of the product development cycle. It is reasonable to expect researchers to be more interested in research rather than expect them to be interested and competent in the numerous other phases of technology transition. When compared to commercial business operations the FNC Process spans a far too narrow, too technical, too limited, talent pool. As was commented in the quote above there are other disciplines required to bring a product to market and these disciplines are not normally found involved in current IPT operations.

A second comment refers to the manner in which the FNC Process was implemented and the inability of the IPTs to manage the investments within their thrust area effectively:

> If every IPT followed the perscribed process, the FNCs would be much more highly considered than they are now. Unfortunately, some FNCs persist in pursuing the desires of individuals or of communities that feel ownership regardless of the likelihood of actual transition.

What this comment seems to suggest is that stovepipes still exist within the IPTs and, as such, constitute an integral component of the FNC Process. Even on paper the FNC Process has shortfalls but when the process is allowed to be mismanaged to appease specific communities these original shortfalls grow into unmanageable voids and the entire process loses credibility.

Another comment referred to the inherent disconnect between the governments' desire to pursue more efficient business operations models and its inability to consistently follow-through on the details of such a pursuit:

> Recent DoN directives seem to promote "industry" models for conducting our business. Do not fully agree as motives are different, but even if we must, DoN fails to stick to the model of industry that places significant and faithful investment in R&D (~2% off the top line) and does not allow that level to be cut. S&T cannot be allowed to be an afterthought. While we complain about a lack of money for current military budgets (and "war" bills), S&T is not successful when viewed as a totally COTS approach. Technology must be worked sufficiently ahead of the insertion point to allow for successfully and affordably integrating the solution into the targeted "system"—both the platform and its network-centric operational scenario. Remember successful S&T means "leading the target" and involves anticipating both needs and solutions—up to 20 years in the future.

The desire to follow industry business models derives from an intense desire to reduce system costs. As the literature search showed, there is a perception within the government that the commercial sector is "better" than a corresponding government operation; that commercial operations are more efficient than analogous government operations; that commercial manufacturers can produce newer, more innovative, products faster, and more cheaply than government entities can; that

commercial entities have higher caliber personnel than that of corresponding government organizations. In some cases this perception will hold true but it is not necessarily true in general. The implementation of commercial "best practices" and "business models" cannot be done in a piecemeal fashion. As this person indicates there are differences between the two sectors and these differences must be properly accounted for in whatever model is used. Many of the things that help make the commercial sector successful are areas where we many times choose to deviate, usually for cost reasons. The net result is that by doing so we sacrifice the gains we had hoped to realize.

The current acquisition process is an example of such an area. Many of the acquisition approaches taken (i.e., COTS) have become so cumbersome that the benefactors are not the taxpayer, nor the warfighter, but the defense contractors that sell the government proprietary systems intended to attract continuous future dividends. Rather than take a much simpler approach, where the government owns the design and a number of contractors would compete for the contract award, the government gets locked into a sole source design and escalating costs. The DoN S&T account can be used to help reduce the costs but S&T investment continues to be viewed negatively within the Navy.

Another comment referred to the problems of communication and focus within the FNC Process. Both of these issues are important for the FNC Process to achieve its objectives. As has been observed by one participant of the FNC Process:

> I have noted repeatedly in my comments that communication and single focus should be the benefit of the FNC Process but I do not believe that all parties have bought into that idea and if they have not done so by now they never will. In my FNC, I continue to see patterns repeat themselves which tells me that nothing is really changing. I had hoped that the FNCs would be a good first step in planning of projects from S&T through fielding and allow for better investment of resources but now I think it is just another flag officer good idea that has gone bad.

Effective and widespread communications, as well as a clear set of objectives, is necessary for the FNC Process to succeed. This comment indicates, in spite of all of the programming and process changes that have occurred over the last several

years, these remain difficulties remain today as they have in the past. This observation seems to resonate with another, made by a different participant, that the FNC Process has not been managed effectively:

> It seems like the Navy tried to make some fundamental and needed changes but they seemed to mismanage it. I think they let the process get completely out of hand and it became a huge political funding food-fight within the Pentagon. Not sure why but it seems like the Navy is doing all they can to avoid using the existing SYSCOM infrastructure. It's ironic as that's probably where their biggest successes have/will come from. It's the SYSCOM ranges, labs and warfare centers that have the in-depth Systems Engineering expertise to implement solutions quickly. Disappointing.

This comment suggests that greater benefits could be realized through a more effective use of the DoN's NRE infrastructure. As several participants have articulated the Navy's Laboratory and Warfare Center infrastructure claims to have experienced a sharp decline in S&T funding and attributes this to a redirection of funds elsewhere by the IPTs. The decline in funding issue aside, it is certainly true the Navy has a substantial investment in its unique NRE laboratory system and that using this infrastructure, and its experienced personnel, to its greatest advantage would be highly beneficial.

h. Acquisition Community Analysis Summary

The survey respondents for the acquisition community included at least one representative from each of the four basic support categories (Principal IPT, Working Group, Project Level, and Other). Of particular interest was an examination of the responses to the questions by representatives of the different support categories. Generally speaking the acquisition community provided more "useful" responses than was the case for other communities' respondents: there were fewer "N/A," "Don't Know" or blank responses.

The survey responses for the acquisition community seem to be reasonable for the support category indicated and consistent within categories. Collectively, the respondents seem to provide a consistent picture of IPT dynamics across the different IPT support groups.

On the whole, the acquisition community provided a more positive assessment of the FNC Process than the other stakeholder communities. The more positive assessment is largely a consequence of the fact the acquisition community is generally seen as the "customer" of the FNC Process and is on the receiving end for the technologies and capabilities under development. When viewed from the acquisition community's perspective, unless there is a technical execution problem, it is completely reasonable to expect a more positive assessment of the FNC Process.

4. Fleet Response Analysis

Survey respondents indicated they supported the FNC Process in an "Other" capacity, primarily as a Naval Research Science Advisor (NRSA) to a Fleet Command. Although responses were requested from a wider variety of Fleet/Force personnel, including IPT representatives, the only replies received were those from ONR's community of NRSA's stationed at Commands throughout the world. Accordingly the survey input provided, on behalf of the Fleet/Force community, might not be completely representative of "the Fleets" input. The survey input provided is considered valid for this community since the NRSAs serve a wide assortment of Fleet Commands, are engaged with senior leadership at these Commands, and knowledgeable of the issues and concerns facing these Commands. The survey response ratio (survey's returned/requested) for the Fleet/Force community was 22.2%.[223]

a. General Questions

In most cases respondents identified the "customer" of the FNC Process as being "the Fleet," or "the warfighter." Acquisition Programs of Record (PORs) were the second most frequently selected choice for "customer" of the FNC Process. One respondent attempted to identify the customer a bit more accurately by commenting

[223] For the Fleet/Force Community, there were 27 survey requests made and 6 surveys returned. Requests were made to Naval Research Science Advisors, Navy and Marine Corps members (military and civilian) of FNC IPT members and FNC working group support members. Because of the large difference in the response rate (between the F/F Community and the other Navy-MC stakeholder communities) it is presumed that a certain number of requests were not completed due to rotational assignment changes of duty station or position. No attempt was made to quantify requests not returned from the F/F Community.

"SYSCOMs for transition; Warfighter for validation." No respondent identified the Navy's Operational Headquarters Command, OPNAV, as a customer for the FNC Process.

Most respondents indicated they felt the goals and objectives of the FNC program were explained to their community. There were two exceptions where respondents felt the goals and objectives were not properly explained to their community. If accurate, the omission of one of these communities, Joint Forces Command (JFCOM), would represent a particularly significant oversight in light of their evolving role in the establishment of warfighter requirements and the intent to have S&T program develop advanced technology programs that would respond to warfighter needs. With respect to the goals and objectives of the FNC program, the observation provided was:

> They were never, to my knowledge, explained to JFCOM, be it the staff officers or the leadership team.

Responses were mixed in evaluating the impact the FNC Process has had within the warfighter community. For various reasons most respondents felt the FNC Process has made little to no impact within their community. In one case the assessment was viewed as little/limited because the "acquisition community eventually responds to Fleet mission needs" while another respondent felt the reason for such little impact was because there were "no fleet demos in the past two years and no new capability was delivered." Another respondent's assessment made reference to an observation regarding the high cost of developing and delivering new warfighting capabilities. Although the respondent did not elaborate further there was an observation made that "capabilities (for ASW) were very expensive resulting in acquisition problems."

Not all respondents were completely critical of the impact on their community. One respondent commented that the FNC Process "gives a voice to the fleet to provide guidance to the technical community" while another respondent felt that the FNC Process would have some impact on transitions but more due to the requirements process itself.

Almost all respondents were markedly critical of the manner through which their community engages the FNC Process. Some indicated they knew of no formal mechanism for engagement over and above the initial warfighter requirements activity that created the FNC's ("We don't – years ago the CCIs influenced the FNCs, but no real engagement since.") while another indicated their S&T engagement has been, and continues to be, primarily through the assigned Science Advisors ("Before: CCIs/NRSA. Now: NRSA"). The Science Advisor's, of course, are not assigned the responsibility of being the Fleet's designated member of the FNC IPT. There was some criticism of the effectiveness and utility of the Fleet Representative position on the IPT. One respondent indicated his community engaged the FNCs poorly and commented:

> Fleet input to FNC Process limited to IPT Fleet rep[resentative], often passive rep from CFFC lacking time, TADTAR and technical background to effectively represent fleet interests. FNCs rarely solicit fleet input additional fleet input. ONR management and much FNC management does not appear to welcome any external input into FNC decisions.

Another observation made was that the warfighter's involvement in the FNC Process was coming "too late in the development process." Another input expressed additional "process" frustrations due to an inability to influence the FNC investment portfolio and a lack of adequate communications between the two communities:

> Although I asked early on (2000) and made suggestions on this, none were ever implemented. Early on, the Missile Defense FNC made contact with JFCOM to ensure that their work would be "born joint" but that relationship, to my knowledge and despite my attempts to facilitate, was 'stillborn.'

Respondents were mixed, and weighted more heavily toward the negative, in their net assessment of the overall importance of the FNC Process to their warfighting community and warfighter operations. Most felt the FNC Process should be important but that the program, as being currently administered, has so far failed to meet expectations. One respondent commented that "The process is not very important as it is currently defined. The products and what the FNCs are purporting to do should be very important to the joint Community – particularly in those areas of joint concern such as

decision-making, C4, ISR, Missile Defense, Fires, etc." Another observation was that the "FNC Process is not having near the fleet impact it should have. Sea Trial process appears to be at least in part a reaction to 6.3 failure to serve fleet needs."

Those that felt the FNC Process was important to their community provided more positive assessments. One important aspect of the FNC Process was the FNC Process' control of a significant percentage of the Navy's S&T budget ("In principle, very important, since it controls half of 6.2 and most 6.3 funding."). A second rationale was due to the increased visibility the FNC Process has offered the Fleet on programs under development ("Provides opportunity to see which technologies are likely to be available beyond the FYDP") while a final comment, although not providing great detail, indicated the FNC Process was "quite important" to their operational community for technology development reasons ("especially related to littoral warfare").

b. Transition Questions

None of the respondents expressed much confidence that FNC products would transition as planned. The most positive statements provided were "Somewhat" and "If funding is maintained." Another comment made was that "Apportionment of ONR budget reductions to FNCs seems to have little correlation to needs of either acquisition community or Fleet."

Almost all respondents indicated they believe FNC programs are being transitioned to existing acquisition PORs and to the SYSCOM R&D offices that plan for acquisition. Only one respondent identified the fleet forces as the transition target.

Most respondents were unsure of and unable to identify any metrics being used by the IPTs. Although nothing specific was provided one respondent did link FNC metrics to OPNAV's recent Mission Capability Package (MCP) assessment studies. Whatever metrics might be used one of the respondents offered an opinion on the usefulness of the metric: "None that affect FNC funding decisions."

The two most often cited obstacles to transitioning advanced technology as originally planned were the current acquisition process (to approve new programs) as well as funding cuts to approved programs already underway. Some of the comments

made suggest a breakdown in communications between the technology development community and the operational community (the warfighter as the end user of the product). With respect to funding cuts it was suggested that these cuts appear to be made without a full appreciation of fleet priorities ("Continual cuts in FNC funding, apparently disproportional to cuts in Navy S&T funding, and allocation of those cuts with little apparent regard for fleet priorities."). Another comment suggested that transition problems were related to the lack of active engagement of the operational community in the FNC Process:

> I do not know if it is the "biggest obstacle" but the fact that JFCOM was never engaged in this process could hamper implementation at a later date considering that current DoD leadership is very focused on reducing redundant service programs in favor of joint solutions (ref: MID-912, rewrites of 5000, institution of new requirements process, etc.) Perhaps it is the "biggest obstacle" after all.

Finally, technology development performance difficulties were also cited as reasons for a lack of transition ("Projects take longer to develop and cost more than expected"). Most respondents were not aware of any agreements on project maturity, cost and schedule ("If there is, it isn't visible to Tycom N8s.").

Although most respondents were not aware of any FNC products receiving funding from multiple IPTs there were two respondents who indicated they knew of cases where this was happening. One respondent provided some specifics:

> Not necessarily bad if efforts are coordinated and complementary (e.g. REDS). An impediment to useful technology development when efforts are uncoordinated and competing for available funding (e.g. KSA and FFP phased array antenna efforts).

None of the respondents were aware of any FNC products that were being funded jointly with another service or agency. Navy participation within OSD's ACTD program was mentioned as a possible joint service vehicle but the respondent was not aware of any such FNC program. Mentioning the ACTD program is significant since it is the Fleet Forces that would normally benefit by the Navy's participation in the ACTD program through the operational evaluation and experimentation of new technologies,

capabilities and operational concepts through the use of the residual systems provided to the warfighter. There was one cautionary comment regarding the definition of joint:

> Be careful how you define "jointly" though. There's Multi-Service and there's Joint. Some things are best transitioned and funded by a single service (ASW, for instance), others may have only multi-service application (fixed wing aircraft) while others such as C4ISR, Missile Defense, Fires, etc. have jointness inherent. Then there's "Inter-agency" which is increasingly becoming as important to the DoD and joint community as 'Joint.'

c. IPT Process Questions

Most respondents expressed the sentiment that, in their opinion, the IPT structure has not been effective. One of the comments made was that "IPTs seem to have mere figurehead role in FNC decision reviews driven by ONR FNC managers and ONR management. Fleet representation does not appear effective in most IPTs."

Responses regarding the IPT decision process (directed decisions or reached by group consensus) were mixed. Most respondents indicated they did not know about and were unsure of the IPT decision-making process or they chose not to answer the question. Those that did respond were in agreement that the IPT was a formal approval body that acted on programmatic decisions done by a working group. One respondent stated that IPT decisions were done "mostly by the FNC ONR staff, with no more than pro forma review by IPTs" while another respondent remarked "proposed FNC projects are discussed in the working groups, recommendations made to the executive panel and approved by the Flag Panel."

Most respondents were not sufficiently familiar with IPT dynamics to be able to comment on the membership turnover frequency. Regarding portfolio selection, most comments expressed the belief that investment portfolios are prepared by ONR staff and merely approved by the IPT functioning as an executive panel rather than as Integrated Product Team in the formal sense of the term. One respondent commented the portfolio was prepared "mostly by the FNC ONR staff, with no more than pro forma review by IPTs" while another respondent provided a more vague observation ("Execution of FNC portfolio decided by IPT").

The objective of establishing thrust areas to respond to warfighter problems is an important, fundamental, component of the FNC Process. One respondent correctly identified the (fleet) Command Capability Issues (CCI's) as being the origins of the individual FNC thrust areas but another respondent expressed frustration at not being able to influence the investment selection process for his community interests:

> I attended one review of an FNC (sorry, I forget the name) but was not asked for my opinion on the IPT portfolio. I did come armed with a fleet capability need but could not get anyone to listen to me.

Responses regarding whether or not there exists a FNC Process for the selection of new programs indicates there are none and various attempts are being explored as a result. The fact that there is no formal process for new programs matches those responses that indicate the process varies by IPT and that some IPTs are more open to outside influence and further along than others in this aspect ("Yes, some FNCs due a RFP and complete evaluation"). Another respondent observes that the lack of a new program selection process presents certain problems for the Fleet ("This seems to be a difficulty"). Another observation made was that the NAVSEA community is making attempts to influence the IPT through one of their internal technology requirements boards ("New programs are presented at SUBTECH").

The responses regarding the number of data calls were mixed. Two respondents replied they were not asked to respond to data calls at all while other respondents acknowledged receiving some number of data calls. The remoteness of the deployed Command can have an affect on these data calls as indicated by one response, "… it was difficult to participate while in the field."

d. IPT Meetings Questions

Most respondents indicated they are not normally informed of IPT meetings and, as a result, are not able to maintain an accurate awareness of IPT development activity and progress.

> Never. Any information I get on FNC meetings comes from SURFTECH staff or CFFC NRSA. I have repeated asked to have a consolidated calendar of FNC events maintained on the ONR web site, without effect.

Most Fleet/Force respondents also indicated they have never attended IPT meetings. Some respondents felt they were not invited ("Generally invitation only").

Knowledge regarding the frequency the IPT meets was mixed. One respondent was not sure, another commented "at least quarterly" and another felt "they all seem to meet too infrequently to exercise effective control of FNC."

There was general agreement that all community representatives did not attend IPT meetings. Interestingly some responders felt that regular IPT participants were from the S&T and SYSCOM Acquisition communities ("ONR and acquisition POC PMO", and "Technology developers and warfare centers").

e. Communication Questions

The questions on communications generated a mixed set of responses. Although a few respondents felt they were in fact being kept adequately informed on FNC matters the majority responded that this was not the case. Some suggested that some FNCs were "better than others" in keeping the information flowing but some were frustrated at the effort it took to stay informed ("I have to hunt for it.").

Some of the respondents indicated they go to the DoN S&T website to get any needed FNC information. One reason for this would be due to their remote location but another reason appears to be due to the lack of information flowing from the IPT's on their own accord. As one respondent commented:

> With some exceptions, the FNCs do not distribute information to me, and apparently don't distribute information effectively beyond the ONR staff and IPT reps. KSA, LASW and OMCM are better in this respect, but none of the FNCs *consistently* keep stakeholders beyond the acquisition POR PMO and the IPT informed.

Other sources of information cited were the ONR IPT POCs as well as the Acquisition PM and performers. Even with the poor information exchange it appeared that most respondents did not feel there was information that might need but did not have (or could not get). In answering this question it seemed that respondents felt they could get whatever information they might need:

> I can always ferret information and use contacts at ONR to ask questions. But after being rebuffed, I instead would go to OSD for my technology needs via ACTDs, JT&Es, DARPA. If I went to ONR, I would go in with a Naval partner (CLF, CMFL, CNSW) who shared a joint issue with me – and never did I engage an FNC to fulfill that need but instead went to NFFTIO money (Fleet/Force Innovation Program)

Comments on the actual usage rate of the DoN S&T website indicated a low usage rate. Only one respondent acknowledged using it "a lot" while others indicated they tried it but did not continue to use it. One respondent commented "I perused it a few times but found it hard to navigate and a lot of the information dated." Although it's possibly the most easily accessible source of S&T information (available anytime over the Internet) most respondents indicated they actually use the DoN S&T website only rarely, if at all, mostly because the content is dated. As another respondent observed:

> With all its deficiencies it is the only source of FNC information readily available from ONR. I rely on SURFTECH, the CFFC NRSA and direct contact with ONR FNC staff for more timely/useful information.

Responses regarding the usefulness of the information at the S&T website were mixed as well. One respondent thought the website was "Useful, but not pertinent" while another assessed its usefulness as being "Little to none." Another respondent observed:

> Content is highly variable between FNCs. A lot of the information is obsolete. Navigation is an impediment to finding useful information even when there.

Besides the information being out of date the content was questioned as well. As another respondent commented:

> I tried to keep up with the various websites – a lot of time there is very little in these websites except old briefings used to justify the original FNC.

The frequency of interaction between survey respondents and the S&T FNC representatives appears to be mixed as well. Some indicated they interact with ONR representatives "often" or "monthly" while others indicated they do so very rarely

or have not yet done so at all. Others commented that the ONR representative was the best POC for FNC information and commented:

> Whenever I need current and evaluated information; averages several times a month but highly variable.

f. Degree of Satisfaction

Although one person responded they were satisfied with the FNC Process, most other respondents indicated they were not. One person was undecided but commented "it no longer seems as responsive to the fleet as it should be." Another criticized the FNC Process as being "totally inflexible."

The fact that the FNC Process has attempted to address Fleet needs was repeatedly mentioned as the one thing that seemed to work. For example, one respondent commented that the "initial program prioritization based on CCIs seems to have worked." Another respondent thought the attempt to focus S&T resources on a limited number of technology areas was something that worked ("focusing critical mass of funding in certain areas").

There were a number of provided as examples of things that did not work with the FNC Process. In general these related to the difficulty in transitioning the technologies as originally envisioned. In a couple of responses it was suggested that the FNC Process was still unable to adequately respond to fleet needs. The lack of synergy between the Navy and DoD regarding the ACTD process was also mentioned as a shortfall as was the FNC's IPT process itself ("decisions still too often driven by ONR and POR staff priorities vice big-Navy need priorities"). S&T program funding issues were offered as still another example of what was not working ("No stability and budget drills").

Summarizing the individual inputs, from the Fleet's perspective the most important aspect of the FNC Process was the fact that an attempt was being made to capture fleet input and transition new technologies to meet the warfighters needs. As one respondent commented, the most important thing was "transitioning technology to fill highest priority gaps in fleet capabilities – not happening often enough or soon enough."

g. *Additional Comments*

The additional comments provided offer insight and expanded views on how the FNC Process has been perceived by representatives of the warfighter communities. One of the comments, aimed primarily at ONR, provides a glimpse into the fleet's perception of ONR's ability to focus on developing technologies of use to the fleet:

> For what it is worth, the rare comments I hear about ONR at flag level are to the effect that too much S&T funding still being directed to what the scientists want to work on versus what the Navy needs. I can't honestly dispute that is still happening, but feel it is unfair to blame the scientists doing the work; a fair share of the blame should be given to the managers at ONR and the acquisition PORs.

There is plenty of blame to pass around within this comment and not all of it would necessarily fall to ONR. As the execution agent for the Navy's S&T program ONR is a Headquarters command which performs an administrative function for the Navy. ONR personnel do not perform the research themselves but they do plan out the programs that accomplish the needed research and development for the Navy. Certainly this function requires that ONR personnel maintain close contact and good working relationships with the warfighters. With the FNC Process an increased emphasis has been to have the S&T programs respond to established requirements provided by the Navy's Operational and Headquarters communities; OPNAV and Fleet/Force representatives.

A more subtle, and more troubling, aspect of this comment, however, is the reference to the only "rare" commentary heard about ONR. The infrequent reference to ONR, and the role they play in technology development, indicates that fleet representatives are not generally conscious of the connection between the advanced systems they use everyday for the defense of our nation and the role of the ONR in planning for the research, development and delivery of these systems. The rare commentary implies fleet representatives do not acknowledge the Navy's S&T community as being a significant player in the Navy's technology research, development test and evaluation cycle. This situation is also mentioned in another comment made:

> I heard ADM (ret) Cebrowski speak recently (at the Naval Industry Conference) and he stated that "Science and Technology that helps the joint Warfighter tends to be without a constituent" and said while he had no answers on how to fix this that either we should change the way the current system is incentivized or create a new organization to handle this.

For the Navy's S&T military and civilian headquarters and laboratory infrastructure – the Naval Research Enterprise – this statement has potentially devastating implications if not resolved within the Navy. These statements indicate the Navy's operational community does not appear to acknowledge the benefits and utility of the NRE infrastructure and, more damaging, that the S&T infrastructure does not have an effective constituent community looking after its interests.

Most of the comments were somewhat critical of the Navy's inability to deliver new technical capabilities and options to the warfighter via the FNC Process. As an example, one comment was:

> Need to get products to the fleet and force for evaluation and input. Stop hiding in labs and get connected & get real!

Other comments addressed timescales and the fleets' desire to have new technology options provided in a much more timely manner. A further observation was made relative to a disconnect between the current slate of approved FNC projects and DoD attempts to deliver technology demonstration hardware to the fleet for evaluation and experimentation purposes. Specifically:

> The fleet's time horizon is almost immediate. The FNCs look much further into the future. It seems that much up-and-coming technology is entering theater through at-sea tests and demos, but not much of this technology seems to have a tie to the FNCs. A notable example is the Assured Access experiment, which is about two-thirds Littoral ASW and one-third MCM. Thus, one would think that the two corresponding FNCs would be engaged, but I have not seen any such connection. Much state-of-the-art technology is being fielded for fleet evaluation during this and similar experiments, yet this technology does not seem tied to the FNCs, or at least the link is not apparent. There seems to be a general lack of awareness here as to what the FNCs are and how they can be of benefit to the fleet. Other technology venues seem to be making a much bigger impact. Bottom line: The FNCs no longer seem closely tied to the fleet, but in order to succeed, they should be.

This comment overlays a fundamental component of the nature of the entire technology development problem, relative responsiveness. The needs of the operational warfighter can certainly be considered "immediate;" we are at war as this thesis is being written. The comment that the FNC's look "much further into the future" is somewhat relative. The FNC's look across the Navy's FYDP which, when compared to the "immediate" present might be considered far into the future. As technology research and development activities or acquisition timelines go, however, the FYDP timeline is considered near-term rather than long-range. Such a fundamental terminology disconnect implies highly divergent expectations.

The lack of participation of FNC projects in fleet demonstrations and experimentation is another important observation. When originally planned the FNC's were "demo-centric" with the intent to deliver new naval capabilities through technology demonstrations. Although the FNC program still strives to demonstrate the developed capability the costs of these demonstrations, considered to be a 'post-6.3' activity, created serious funding problems. In addition to the costs of these demonstrations, the intense need to transition the S&T products to an acquisition program eventually caused a shifting of the emphasis from warfighter capability demonstrations to one of meeting acquisition programmatic cost and schedule requirements for the tech-insertion "window of opportunity." This shift is relevant to another comment made which referred to the Navy's decision to "choose" not to participate in OSD's ACTD program over the past several years:

> The way in which ONR has chosen to "play" in the ACTD program is also indicative of a "head in the sand" organization unwilling to accept the new rules that are forming. I would suggest that ONR consider changing the focus of some of the FNCs to Future Joint Capabilities – become a leader in joint S&T by inviting the other services in (perhaps by using the TARA and associated committees) and expand their IPTs to include combatant commanders as appropriate.

Certainly the Navy's participation in the OSD ACTD program has not been very robust, as is seen by its funding track record over the past several years.[224] There are a number of reasons for the lack of vigorous support in the past, including cost, budgeting and a lack of technical coordination and cooperation among the various (requirements, S&T, acquisition, fleet, etc) stakeholder sectors within the Navy.

5. Summary of Participant Surveys

A "convenience" survey sample was selected for use in this thesis research. The decision to use a convenience sample was made for a number of reasons:

- The survey participant pool could be directly selected.
- The survey would be more convenient for the respondent.
- Survey responses could be easily correlated.
- The survey response rate could be easily determined.
- The survey contained questions of a somewhat sensitive nature.
- Any feedback provided would be directly useable (anonymously).
- I had access to the e-mail addresses for the target population.
- The survey could contain a large number of important open-ended questions.

64 surveys were electronically circulated to specific individuals to solicit stakeholder feedback by actual participants in the FNC Process. Of the 64 surveys sent out 25 surveys were completed and returned for an overall survey response rate of 39%. The number of responses across the four stakeholder communities were approximately equal; five were received from the OPNAV community, seven were received from the S&T community, seven were received from the Acquisition community and six were received from the Fleet/Force community.

The 39% survey response rate is not considered unusual and is consistent with independent survey response results published by the RAND Corporation[225]. In their study they found the literature contains some fairly rigorous attempts to compare the response rates of surveys delivered via e-mail to those delivered via traditional mail and

[224] The Navy is not unique in this regard as all Services have taken similar positions. OSD priorities for joint Service programs, products and capability demonstrations typically are in conflict with priorities within any single Service. Since the Services, and not OSD, "pay" for the technical work being done their priorities tend to get the final say, unless overwhelming pressure is applied from external sources.

[225] Schonlau, M., Fricker Jr., R.D. & Elliott, M.N. (2001). Conducting Research Surveys via E-mail and the Web. Santa Monica: The RAND Corporation. Publication MC-1480-RC.

the internet. Their results conclude surveys using e-mail as the sole response mode generally did not achieve response rates equal to those of postal mail surveys or those using the internet. Sample sizes vary but the response rates experienced for this thesis are roughly consistent with those of the RAND study.

In contrast to the personal interviews, not all of the people contacted agreed to participate in the e-mail survey. In most cases those who chose not to participate simply failed to respond to the original request. In other cases persons who agreed to participate later failed to return the survey. In such cases only one attempt was made to request a return of the completed survey. In two other instances, as a likely result of their frustration with the process, persons informed me directly they did not wish to complete the survey and thereby contribute anything further to the FNC Process “churn.”

Survey questions were developed based on a broad knowledge of the goals and objectives of the DoN FNC technology transition process. Each survey asked two general questions – which stakeholder community the respondent represented and the type of support they provided the FNC -- which were used to group the responses for later analysis. The returned surveys were grouped into one of four stakeholder communities; OPNAV, S&T, Acquisition and Fleet/Force. For analysis purposes the original intent was to use the five stakeholder communities identified in the survey (S&T, Requirements, Acquisition, Resources and Fleet representative) but the response rate was from the Requirements community was so low that the Requirements community (OPNAV N7X, typically) and the Resources community (OPNAV N091, typically) responses were eventually combined, for analysis purposes.

The survey then asked 31 questions across six categories; FNC General (4 questions), Transitions (7 questions), IPT Process (6 questions), IPT Meetings (4 questions), Communication (6 questions) and Satisfaction (4 questions). There was one final category provided, Additional Comments, where space was provided for the respondent to offer additional input of their choice or for additional space to provide clarification for a response to an earlier survey question. Finally, a “vertical” analysis was conducted of the responses within each of the four major stakeholder communities.

E. OTHER INDICATORS

1. Website Usage

The DoN S&T FNC website[226] was established on NRL servers in early 2000. This website was intended as a central clearing house for sharing DoN S&T information, including FNC information, among stakeholder communities. Figure 6 shows the user login frequency from inception (April 2000) through December 2003.

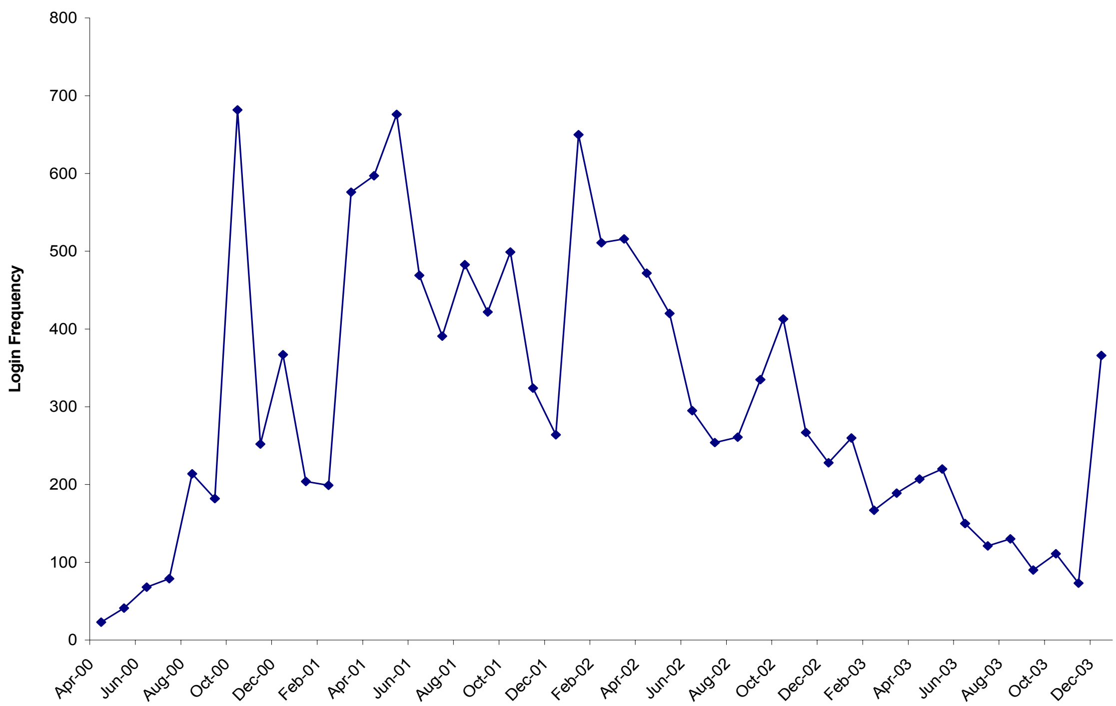

Figure 6. S&T Website Login Frequency (Apr00 – Dec03)

The graph of Figure 6 shows an initial high rate of usage as the website was stood up and the FNC program building process was in full swing (through 2001). After this initial high rate of activity there is a clear negative usage trend as increasingly fewer users choose to access the website for data. This negative trend is likely a reflection of the perceived utility of the website; as users find the S&T data is not updated and maintained they do not return. This overall trend matches the comments made in the

226 DoN S&T website, https://donst.nrl.navy.mil/cgi-bin/login-form.cgi, last accessed July 2004.

survey responses. The rapid frequency increase in December 2003 is likely due to internal activity underway at ONR and NRL to update the website and data.

The literature survey of business models and practices revealed a strong utilization of internet technologies for conducting business operations in an efficient, effective and powerful way. Literature on the Dell Computer Company, for example, revealed the extent to which Dell used their web-based servers. Although the internet and web-based technologies are obviously being used by the DoN S&T Community in many areas to conduct a wide range of general S&T business operations (BAA announcements, etc) the data collected does not provide strong evidence of a similar reliance or utilization of the internet technologies for the conduct of FNC business operations.

2. Congressional Influence

Unavoidably, politics has always played a role in the DoN S&T Program (all funds come from Congress). Recent data indicates the role and level of Congressional oversight is increasing: the S&T Program is becoming increasingly more “political.” One indication of the increased role of the Congress is evident by the steadily increasing amount of Congressional “plus-ups” to the S&T budget. Such a “plus-up” is money added to the budget which is very clearly identified for a very specific purpose, usually to fund work being done by a contractor in the Congressional district of the submitter. Typically these projects have been developed outside of the military and do not have S&T, OPNAV or acquisition support. Table 1 provides recent trend data for Congressional plus-ups.

Year (FY)	PRESBUD Request	Appropriated	Congressional Plus-ups
2000	$ 1,420,110	$ 1,757,520	$ 345,800
2001	$ 1,463,103	$ 1,856,453	$ 396,350
2002	$ 1,713,170	$ 2,085,433	$ 395,175
2003	$ 1,607,253	$ 2,080,336	$ 510,085

Table 1. Navy RDT&E S&T Budget Plus-ups[227]

The increasing level of "plus-ups" can be viewed from different vantage points. One is as recognition of the service that ONR performs for the DoN – the execution agent for science and technology. From this vantage point congressional representatives are viewed as the customer and plus-ups are a good thing, being responsive to customer (i.e., congressional interest) needs. Congress uses ONR simply as the vehicle to administer and execute naval S&T programs which are of priority interest to congressional members and their constituents. There is no internal naval review of warfighter need or utility because Congress, as a representational body of the citizens of this country, has the ultimate say with respect to our nation's needs and resources. Used in this manner ONR does not serve a technical function but merely serves as an administrative "pass-through" between Congress (supply) and the constituent (demand, and customer). Congress uses ONR because ONR is the most convenient vehicle to pass resources through to constituents, is efficient at administering contracts, and has the technical expertise to effectively manage the contract.

A second interpretation of this trend, however, is as a metric indicating the current S&T processes are not effective and that organizations are "going around" ONR and taking their case directly to Congress for more immediate action. From this perspective

[227] Appropriated less President's Budget does not equal Congressional plus-ups due to S&T receiving specific Congressional decreases each year.

the DoN S&T processes have become too bureaucratic and non-responsive to perceived warfighter needs.

The problem with a heavily politicized process is that politicians get rewarded for delivering benefits to constituency groups. The result is an environment in which substantial change is risky and politicians are punished more for trying something and failing than for running a mediocre or ineffective organization.

F. BUSINESS MODEL CONCEPTS

Using business model concepts presented in Chapter II as a benchmark, no evidence was found to support the notion that a robust and effective FNC business model is in place within the DoN. The data collected for this thesis through a broad range of literature research (Chapters II, III and IV), personnel interviews and stakeholder survey responses confirm such a lack of a strong S&T business model.

1. Value Proposition

A convincing case has not been made regarding the value provided to the DoN by the FNC Program. There is no objective reporting system in place and no quantifiable metrics by which to measure technical progress and eventual success (or failure). Although several stakeholders expressed the opinion the FNC Process is an improvement over previous technology transition processes (i.e., the ATD process), the overall assessment from the stakeholder community's appear to be very mixed. Indeed, the FNC Process suffers from many of the very same criticisms (high number of bureaucratic reviews, etc) of the ATD process. Furthermore, both processes fail to provide stakeholders with easy and reliable access to information causing a high degree of frustration. Although the FNC Process has done a good job in raising an awareness of the S&T account to the Fleet/Force Stakeholder Community it does not articulate a clear reason for and use of the FNC investments. The Fleet/Force Community is interested in the FNCs because they perceive the investments to be "their money" and they do not want to lose it. Beyond that perception there is no widespread understanding as to how to influence the investments. Indeed, survey respondents expressed a great deal of

frustration in the FNC Process due to their general inability to direct investments towards projects that would directly benefit them. Although the Fleet/Force Community has been vocal supporters of the FNC Process, the target of the technology transition process has been the Acquisition Community via Technology Transition Agreements. Unless the FNC Process Business Model is changed to target the needs of the warfighting community in a much more immediate and direct way the support shown by the Fleet/Forces stakeholder community can be expected to greatly diminish in a rapid manner.

2. Product Offering

The DoN FNC Program services the S&T needs of the entire DoN over the FYDP. There are more than 200 individual products being planned for and supported across twelve FNC IPTs servicing all warfighting communities within the DoN. Although the level of awareness of the S&T account has increased as a result of the FNC Process, spreading the investment across so many projects has resulted in a very fractured constituency. Many believe there are too many programs being supported by the current process. Furthermore, the effectiveness of the current process is unknown. Across all naval communities the participants in the process have expressed a general lack of awareness of examples of specific programs that have transitioned or even the status of current programs being supported.

The DoN capabilities-based approach for the FNC Process, as envisioned, is a ‘top-down’ approach which requires the S&T community to respond to requirements developed by the warfighting community. The OPNAV Resource sponsors have been designated as the Chair of the IPTs and are responsible to define the requirements for the S&T community. The later addition of the Fleet/Force representative was to increase buy-in of the FNC Process to the deployed warfighter.

The FNC Process, as implemented however, takes a “bottom’s-up” approach because programs typically originate from the S&T community via working groups or committees with approval or general guidance by the IPT. This approach has been criticized as being easily influenced by special interest programs rather then developing

capabilities derived from sound warfighting analysis. It appears likely this approach is used, however, because of the OPNAV community's demonstrated inability to effectively engage the FNC Process to the degree required due to other higher OPNAV priorities (budgetary). Very recent changes to the FNC Process now levy a small staff within OPNAV N70 with the responsibility to define the requirements for the future warfighting capabilities.

3. Resources

The DoN has considerable resources (personnel, facilities, etc) at its disposal but the ONR does not appear to be sufficiently engaged with its NRE components in order to take advantage of the "corporate" resources necessary to deliver new capabilities to the warfighter in a more rapid and cost-effective manner. Along a similar vein the management of the NRE components do not appear to be proactively engaged in activity designed to attract FNC work, either.

The Navy Laboratories and Warfare Centers which make up the NRE are, essentially, the "value chain" for the DoN S&T account. Critical DoN expertise is employed across the NRE. Significant systems engineering, systems integration, and analytical capabilities exist across the NRE but it does not appear that the FNC Process will take advantage of these NRE capabilities as they view them as costly and in competition with outsourcing contract priorities. As a result, the effective utilization of this "value chain," critically important to any successful business operation, appears to be highly inefficient and possibly discouraged.

The desire of the FNC Process is to develop solutions to warfighting capability needs and develop and transition these solutions in a rapid manner. A more collaborative technology transition process would define the warfighting capability needs and use the appropriate expertise within the NRE components to develop a number of competing options and potential solutions to meet those needs.

4. Financial System

As indicated in personnel interviews and participant surveys the DoD POM process used to resource the S&T account is ineffective. The DoN level of investment for the FNC Program has steadily declined since the inception of the program as the Navy struggles to comply with increasing DoD guidance and other administrative demands on a budget that has not seen real growth in a number of years. Complicating matters is the fact that the level of Congressional plus-ups has steadily increased over this same time period, greatly reducing the amount of discretionary dollars available for use to the DoN to develop and deliver the warfighting capabilities desired. These actions have occurred while we are at war and the corresponding budgets of other agencies (i.e., DARPA, etc.) have seen significant growth.

As resources have gotten tighter the IPTs have been forced to make their own tradeoffs to comply with ever-increasing fiscal constraints. The data supports the perception that IPT investment decisions have been made without serious joint Service, or even joint IPT, coordination and collaboration. As a result the FNC Process can not be said to support the OSD emphasis on joint Service operations and continue to be viewed as inefficient and "stovepiped."

G. CORRELATION TO LITERATURE REVIEW

This section offers a brief comparative analysis of the major points found in the literature review to FNC Process feedback captured through the FNC survey responses and the interviews conducted.

1. Cost and Capability

The cost of weapons and platforms has been accelerating, but so has their capabilities. An analysis that focuses only on the cost side of the equation runs the risk of missing the main point – is the Navy getting the best value? Getting the best value has been a primary justification for the Navy's investment in its in-house technical capabilities. What appears to be happening is that the NRE's role of independent advisor has been greatly devalued. This devaluation affects the Navy's ability to function as a

smart buyer and limits the NRE's usefullness as a tool to ensure the Navy does get the best value.

2. DoD - Commercial Market Comparisons

An analysis of commercial business operations, when compared to that of the DoD, were found to be similar enough to merit close scrutiny, especially in the areas of product development planning strategies and cooperative technology development techniques.

One of the primary tools used by the commercial sector was a business model. Numerous sources, and persons, emphasized the use of an accurate business model was essential to planning successful business operations. The business model, built around the revenue flow for a business, dictated the important business decisions. The use of any such business model by the DoN, or even the Defense Department for that matter, was not supported by the evidence collected for this thesis.

The FNC Process revealed the Navy has made some effort to mimic commercial business concepts. Business terminology (such as "Corporate Board") are sometimes used and business plans were required by the FNC IPTs for funding projects. These efforts, however, seem superficial in the context of their implementation. Enough fundamental differences were found between the commercial and defense approach to question the thesis assumption that the DoN has approached the technology transition process in a business-like manner.

3. Civilian-Military Chain of Command

Significant differences in the leadership and management approaches in business operational styles were found to exist as a result of fundamental differences in the commercial (civilian) and military organizational structures. The Defense Departments' (military) "Command and Control" leadership style and use of available personnel (civilian and military) on a rotational basis were much different from that found in the

literature search for the commercial sector. The personnel constraints on hiring and firing within DoD were also much different from that of the commercial sector.

Even with such differences, however, the literature search produced evidence which showed there have been cases where the DoN has been able to operate more effectively and transition technology to the warfighter at a quicker pace[228] – although they did not articulate it in such a way, in those cases they operated more "like a business" than today.

a. The New C&C

When comparing the experience of the FNC Process with the (past experience) data uncovered during the literature survey it is clear that all communities are dissatisfied with the results achieved so far and that further improvements are not anticipated without further significant changes. There is virtually no doubt that process changes are still needed in order to realize the increased technology transitions originally desired of the FNC Process. Although it would be highly controversial, past experience with innovative Navy "experiments" that appear to have been much more effective than the current FNC Process offers a possible framework for such additional changes. The data collected suggests fundamental changes are needed to move the DoN away from the traditional C&C–Command & Control–leadership style to a new paradigm C&C–Communication & Collaboration–leadership style. The Command & Control leadership style is a natural fit for the military warrior mission but, as the literature and past experience has repeatedly demonstrated, this leadership style has not been generally effective in leading organizations whose mission is to innovate and develop and transition new concepts and capabilities. The positive results of a few novel DoN experiments suggest at least two components to be critical to the success of any approach taken:

(1) ***The Importance of Communication***. The need for, and importance of, communication was found throughout the literature. The need for additional communication was also universally mentioned by survey respondents and persons interviewed for this thesis. To its credit the FNC Process has gone to great lengths to increase the visibility of the DoN S&T planning process throughout the DoN

[228] A quicker pace equates to the commercial sector as a reduced "Time-to-Market."

and the increased visibility does generate an increase in the communication rate among the stakeholder communities. However, based on the feedback provided from the senior leadership personnel interviewed and the FNC Process participants responding to the survey there is more that needs to be done.

(2) ***The Need for Collaboration***. As with communication, the need and importance of collaboration in developing and transitioning new products was found throughout the literature. In reviewing the survey responses one thing that is clear is the complete lack of any reference to any sort of collaboration activity in any shape or form. There is no significant reference to collaboration among FNC IPT's nor is there any significant reference to any joint Service collaboration, a primary OSD objective. In fact the only collaboration activity referenced appear to be those that were mandated by previous (pre-FNC) agreements. The FNC Process does attempt to encourage intra-Navy collaboration through the use of the IPT construct but the IPT framework does not appear to have been effective in and of itself. The IPT framework, as a consensus-based oversight group, was formed at too high a (DoN leadership) level to facilitate collaboration at the project level. As it devolved the IPT framework seemed to, effectively at any rate, simply map the DoN S&T resources into OPNAV slices to obtain corporate Navy buy-in regarding the S&T projects under development. There is no evidence that, at the DoN level, collaboration was ever attempted with any other Service (such as with an ACTD). From the feedback provided there is no evidence that there was any significant effort to collaborate within the Navy (for example, through a cross-FNC effort) either. The one very significant exception was the Navy-Marine Corps S&T collaborations that have underway over the past several years. The MC success within the FNC Process can be directly attributed to the proactive approach the MC have taken to the FNC Process and their efforts in making the Navy-MC collaborations works. The MC success' within the FNC Process clearly show that collaboration efforts can work.

b. Creating the Right Environment

When comparing the body of literature for what worked and what did not regarding technology development and transition to the experiences reported for the FNC Process a couple of items appear to clearly separate "from the pack" of all issues

encountered. These items can roughly be generalized as "environmental" issues and point to a need by the DoN to promote a more positive technology development "environment."

(1) ***Having the Right People***. As past experience shows, and the literature strongly supports, having highly competent people doing jobs they have been trained for is a primary metric for any successful organization. Equally important, but possibly not as obvious (certainly more difficult), is being able to remove people from performing functions they are not competent to perform. The need for highly competent people exists at all workforce levels; managerial excellence is necessary as well as technical excellence.

(2) ***Fostering Cooperation***. Both the survey responses and personal interviews reveal a significant level of frustration with the FNC Process, at all levels of participation. There is little evidence in the data collected to suggest there was a significant degree of cooperation among stakeholders within the FNC Process. Cooperation in this context is intended to be different from collaboration activities on a specific project. Many of the survey responses convey clear frustrations at an inability to obtain data on the S&T Program of Record, individual S&T projects and IPT priorities. Many of these frustrations may be linked to the poor communication habits commented on earlier but they appear to be widespread and go beyond organizational boundaries. In some cases personnel within ONR, for example, reported similar difficulties in obtaining FNC information as those outside of ONR.

The difficulties in cooperating are also reported within the literature for organizations attempting to transition technology in the commercial sector. In Corey's study on consortia, the technology "delivery process" was very involved and sometimes required an intense level of cooperation (and technical collaboration) among consortia members.[229] Indeed, the level of cooperation appears to have been at degrees higher then found in the current FNC Process. The consortia study provides evidence that such cooperation, although difficult, can achieve good results.

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[229] Corey (1997). pp 47-54, 132-142.

Post-WWII Navy (BUORD) organizational "experiments" with innovative approaches to developing and delivering ordnance to the warfighter in an accelerated manner provide insight into another form of cooperation largely unaddressed elsewhere–that of the critically important roles between the military and civilian leadership in technology development organizations. The literature regarding the BUORD "experiment" at China Lake reveals an unusually high degree of cooperation between (local) military and civilian leadership at China Lake. This highly effective leadership team is widely credited with providing the bureaucratic buffer which allowed the scientists and engineers at China Lake the flexibility needed to develop and deliver innovative products at unprecedented rates. As innovative as such a unique military-civilian partnership team is, the literature also shows that such an arrangement was resisted from "corporate" Navy and steadily devolved to one more amiable to senior Navy leadership.[230]

The high degree of S&T cooperation between the Navy and Marine Corps is a testament to the positive results achievable through cooperative planning activities. The FNC survey responses indicate the Marine Corps personnel have demonstrated a high degree of cooperation, among the Marine Corps team at Quantico, Virginia, and, within the FNC framework, between Navy and Marine Corps at ONR. As the literature review of the FNC Process revealed, this high level of cooperation was the result of senior Navy leadership planning prior to the implementation of the FNC Process. The important factor was that this new cooperative leadership arrangement[231] was executed in earnest by the Marine Corps team. As the survey responses indicate the

[230] A senior civilian SES (retired) interviewed for this thesis commented that the original organizational arrangement at China Lake was permitted by "Corporate Navy" only due to the personal integrity and influence of the personnel (Navy Admirals and civilian scientists) directly involved. Once these persons moved on or retired "Corporate Navy" immediately acted to dilute the authority and responsibilities of the unique operating arrangement at China Lake.

[231] The "cooperative" leadership arrangement mentioned here refers to the DoN agreement that created a Marine Corps position as Vice CNR (VCNR) at ONR. This senior level of cooperation within DoN (between the "Blue" Navy and the "Green" Marine Corps) is widely viewed as a success and has been instrumental in the Marine Corps' influence on the establishment of DoN S&T priorities and the allocation of resources to address those Marine Corps priorities.

Marine Corps approach to the FNC Process was vastly different from the OPNAV approach, and was far more successful as a result.[232]

4. Group Theory and Decision-making

A comparison of the experiences reported with the FNC Process to the literature for group behavior theory and collective action decision-making processes was insightful. For the FNC Process, an Integrated Product Team (IPT) framework was the primary vehicle for group action and was based on a consensus decision-making agreement among the DoN stakeholder community representatives. The use of the IPT structure stems from acquisition reform initiatives within DoD dating back to SECDEF William Perry when it was considered a "best practice" used by the commercial sector. Ironically, an extensive survey of the literature revealed no significant reference to the continued use of the IPT framework within the commercial sector. The IPT framework appears to be primarily an acquisition community consensus-building tool with no apparent or widespread use or utility outside of the DoD acquisition community. Furthermore, previous thesis' and independent reports which examined the effectiveness of the IPT framework within DoD were found to be largely critical of the IPT model and universally reported negative results–the consistent conclusion throughout these independent studies was that Integrated Product Teams have not been effective for DoD programs.

With respect to the implementation of the IPT model for the FNC Process, the experiences reported by the survey respondents as well as the feedback provided by those persons interviewed suggest that some of the same IPT shortfalls reported in the literature continue to plague the FNC Process' implementation of the IPT. For example, in a manner completely analogous to the consortia experiences reported by Corey in the

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[232] Generally speaking, OPNAV did not always support IPT Working Group meetings with military personnel but relied on detailees and contractor IPA's to provide OPNAV input. In contrast to OPNAV's approach to the FNC Process, the Marine Corps appear to have always ensured a uniform Marine attended a Working Group meeting for each IPT of interest to the Marine Corps. It was commented that the lack of a OPNAV uniform sent a clear message regarding the level of importance of the S&T planning process and the results appear to reflect that degree of importance.

literature, the consensus-driven nature of the IPT's decision-making process tended to favor low-risk, near-term projects.[233]

For comparison purposes, it is informative to note the literature does mention other organizations which have executed technology development (and transition) programs of roughly comparable size and scope to the Navy's FNC Process. As an example of a comparable program of approximately the same magnitude (resource-wise) and duration was the National Institute of Standards and Technology (NIST) Advanced Technology Program (ATP). The NIST ATP provided $556M over a four-year period (1990-1994) in support of 177 R&D projects.[234] This compares to the FNC Process of roughly $500M (per year) in support of 200 projects over the six year FDYP.

Similarities were found between the behavior of the FNC IPT operations and the behaviors predicted by group theory, the field of mathematics that studies the dynamics and decision-making behaviors of groups of people, and game theory, the field of mathematics that studies strategic behavior in competitive situations. Many of the frustrations and comments provided by participants in the FNC Process strongly correlate with the predictions found in the literature.

5. Difficulties with Change

The experiences of the FNC Process, as evident through the survey responses and the personal interviews, are consistent with the difficulties in implementing fundamental changes reported in the literature. Much of this difficulty can be traced back to the concept of paradigms as developed by Thomas Kuhn. For truly innovative–disruptive by any measure–technological developments the difficulties experienced in the development of the turbojet engine documented by Edward Constant are very informative. The Navy, in particular and as documented by William McBride, has historically struggled with embracing technological change.[235]

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[233] Corey (1997). p. 152.

[234] Corey (1997). pp 119-120. Although the NIST ATP program is smaller than the Navy's FNC Program, a reasonable comparison could be made against a couple of IPT's within the Navy's FNC Process. Although informative, such a comparison is beyond the scope of this thesis.

[235] McBride (2000). pp 5-7.

Much of the Navy's struggle appears to boil down to a fundamental lack of "trust" which results from its deeply ingrained "Command & Control" warrior ethos. A lack of trust is one common thread found throughout the responses in the survey's returned by participants of the FNC Process. Ironically, since the thesis of this research was an assessment of the government's ability to operate more "like a business," the essential need for "trust" was mentioned by both corporate persons interviewed for this thesis.

The issue of trust might also be found in the Defense Departments' dual military-civilian leadership structure and the subtle struggle over "who" actually controls the military. With respect to technological development within the military the issue is particularly relevant. The Navy's history of technological change, documented by William McBride,[236] and the high-level military and political struggles that Vannevar Bush experienced as Director of the Office of Scientific Research and Development during WWII are informative.[237] Even with these struggles the literature does provide a few examples of organizational "experiments" where a military-civilian operating arrangement was established that was conducive to highly innovative technological developments that were transitioned to the warfighter in a greatly accelerated timeframes. The key, of course, is in understanding the defense "environmental conditions" which allowed such experimental leadership arrangements to arise and flourish and why they were eventually abandoned.

6. The Importance of Technology Demonstrations

When attempting to transition technical developments to operational status the literature supports the notion that functional demonstrations of the technology are extremely beneficial for the acceptance of those developments. In his study of R&D consortia Corey provides numbers examples of the utility of technology demonstrations.

The FNC Process, a more ambitious derivative of the previous Navy ATD process, started out as a demonstration-centric process but devolved to a delivery-centric process which relies on the negotiation of technology transition agreements as a

[236] McBride (2000).

[237] Zachary (1997). pp 159-163.

necessary requirement for IPT funding. The exact shift from a demonstration-centric process to a delivery-centric process is difficult to pin-point precisely from the literature review but appears to be due, in part, to the cost of funding the number of technology demonstrations which would have been required. From the feedback provided in the survey responses there is a very mixed assessment as to whether or not the transition agreements are credible. In at least one survey response there was acknowledgement of transition agreements that were not met and several other respondents expressed skepticism regarding the technology agreements negotiated. From the feedback provided by respondents there was little evidence to support the notion the FNC Process has been able to facilitate the delivery of new capabilities to the operational community in a more focused and accelerated manner. One reason for the lack of such evidence, understandably, is due to the short timeframe the FNC Process has been in effect.

7. Lack of a Technology Assessment Function

One of the key issues, found throughout the literature as well as in the FNC Process feedback and in the personal interviews conducted, was the need for a mechanism to assist management regarding fundamental technical resourcing decisions. The complexities of technology development processes have consistently presented tremendous challenges to the manner in which we measure and assess them. The failure to make appropriate (resource allocation) decisions early in the development cycle results in valuable resources being spent on technical options that will ultimately not be successful or militarily useful. Over time the accumulated net effect of such a situation might, arguably, cost the Navy hundreds of millions of dollars in "lost opportunity costs." The literature shows this to be a fundamental technology development problem that has existed for years and, furthermore, is one not limited to the military. For example, the elimination of the Office of Technology Assessment (OTA) left Congress without an organizational tool to tap into for the expert scientific and technological advice needed for effective legislative decision-making. Similarly, the DoN has no organization that is chartered to perform a similar function for Navy technical decisions. This deficiency has

become increasingly critical, as more and more of the decisions faced by the DoN and the Congress require judgments based on highly specialized technical information.

The Office of Naval Research could, using its technical naval expertise across the NRE infrastructure, fill such a role for the DoN but, at the current time, does not. Since Congress is the source of Navy resources there is a tendency to view Congress as the ultimate "customer" but the Navy's interface with Congress is predominantly passive: Congress uses ONR largely as a conduit for funding projects of interest to influential members. The literature substantiates that successful businesses do not maintain a passive interface with their customers, however. The FNC survey responses indicate that current congressional influence has been viewed largely as disruptive to the Navy's S&T planning processes. The Navy would be better served by having ONR assume a more proactive interface with Congress through some form of technology assessment role for the entire DoN. Such a proactive dialog should help identify and communicate serious technical issues and funding shortfalls that would require congressional action to resolve. At the current time there is no obvious mechanism for the Navy to engage with Congress in such a dialog.

8. Collaboration Mechanisms

The most interesting collaboration mechanism found in the literature was that of the R&D consortia described by E. Raymond Corey.[238] His (1997) study concluded that although R&D consortia differed they were largely successful in developing and transitioning technology's to consortia members. In his final analysis the R&D consortia model was useful and he predicted that consortia-type organizations will continue to evolve over time. Consistent with research findings throughout the literature Corey found one of the most important conditions for successful consortia was the recruitment and use of highly competent personnel in the formation and the management of consortia operations. The R&D consortia placed an emphasis on and made frequent use of

[238] Corey, E. R. (1997). Technology Fountainheads. Boston: Harvard Business School Press. In this informative study Corey examines the economic, social, and political aspects of six consortia in detail.

customer liaison personnel exchanges to assist in communication activities and to better understand important issues and concerns.

In many cases the consortia have a significant political component as well. Congress usually played a role in the initial formation of a consortium and, in many cases, provided initial "seed" funding to entice the formation of the consortium. The consortia formed as a result of highly visible national need and served Congress as an instrument of national policy while being coupled to an integral part of private enterprise. Indeed, the more successful consortia came from private industry. In contrast to this, Corey found that government-funded consortia (specifically, those from the US, Europe and Japan) generally failed to meet expectations. Part of the problem appears to be that government involvement caused the consortia to have multiple goals, some of which were economic, some were political and others that were not necessarily aligned with consortia member interests. Those organizations which were heavily funded by the government, for example, were vulnerable to sharp budget cuts and shifts in public policy, national income and political priorities. With obvious relevance to the FNC Process, this instability created significant problems for the consortia involved.

Typically, the consortia were formed as a result of strong economic incentives that existed for a clearly identified group membership. Commercial competitors joined consortia but were very deliberate in defining clear collaboration agreements. As a result, consortia mission statements were typically very focused and unambiguous and the consortia survived only as long as they continued to fulfill the needs of the members (they delivered an acceptable "return on investment" to the participating corporations).

Decision-making within the consortia appeared to be somewhat analogous to the consensus-based decision-making framework of the FNC Process. The focus of the consortia was usually short-term (advanced development-oriented) rather than long-term (basic research-oriented). Within each of the consortia studied the projects selected were normally required to benefit existing "customers" and this stipulation ended up discouraging projects which would have tended to entice new markets and new customers.

Many of the fundamental components of the R&D consortia appear to be analogous to the core components of the FNC Process. The difference appears to be in the implementation methods used rather than in the components of the two approaches (R&D consortia and FNC's) themselves. Without having explored this matter further it appears the R&D consortia were implemented in a far more "deliberate" manner than has been the case so far with the FNC Process.

H. SUMMARY

This chapter presented data from a wide spectrum of sources and provided an analysis of the material collected. Administrative data within the bounds of DoN S&T Process itself (instructions, guidance memorandum, briefing material) and independent data from outside the S&T Process (open literature reviews, congressional reports, government studies, website server statistics) were used to provide an indication of the success of the DoN's ability to operate more effectively and in a "business-like" manner.

FNC survey response feedback data from participants with first-hand knowledge of the FNC Process was supplemented with information obtained through personal interviews with senior-level Defense Department and Corporate leaders. This information was assimilated to obtain useful insight into some of the issues encountered when attempting to operate the government "like a business," technology development and, ultimately, transitioning of those technology developments to operational customer products.

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VI. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

This thesis examined the objectives, processes, and methodology of the Department of the Navy's (DoN) most recent Science and Technology (S&T) technology transition process–the Future Naval Capability (FNC) process–with a business process perspective. The general notion of a DoN S&T "business environment" was explored to assess whether or not a military-based business environment has been conducive to realize technology transitions in an accelerated manner, as was the intention of the FNC Process. This research identified a significant number of fundamental issues and suggests changes to the technology transition process that might prove beneficial to future efforts.

The research methodology used for this thesis consisted of collecting relevant data from a variety of independent sources for correlation and analysis. Because the FNC Process affects all naval communities, this approach was used as a way to minimize biases from any one particular stakeholder community in an attempt to reach balanced and objective conclusions. The data collected consisted of an extensive literature search of a number of technology development and business-process concepts, personal interviews, and stakeholder feedback using an electronic survey. The (face-to-face) personal interviews were conducted with senior-level DoD, DoN, and Industry representatives who were directly involved in either technology program planning processes, the DoN FNC Process, or both. An anonymous electronic "customer feedback" survey was used to target a population of specific individuals who were active participants in the FNC Process. Generally speaking, the respondents to the electronic survey were at a lower management level than the personnel interviewed: survey respondents were typically at a working level while the senior personnel interviewed were at "corporate" decision-making (Flag/SES/VP) levels.

The survey responses provide a first-hand account of the end result of the FNC technology transition process, as experienced by personnel across all stakeholder communities. These feedback responses, representing the net effect of the FNC planning

process, were examined in light of the remarks provided by management personnel interviewed to obtain insight of management policy and interpretation. Both collections of data were further examined under consideration of the background data provided by the literature search. The intended net result was to produce a detailed study that would link history and theory to management planning processes to, finally, the actual implementation processes and results achieved.

1. Original Thesis Questions

This thesis addressed the questions presented in Chapter I. A literature search of business principles and relevant government guidance was presented in Chapter II. Appendix B provides a summary of the variety of revenue approaches commonly used in commercial business models. Chapter III presented an overview of the DoN S&T Program and described the changes in the execution of the Navy's S&T Program. Chapter IV provided a chronological history of the implementation of the Navy's FNC Process. This chapter also described a number of significant changes to the FNC Process which have been implemented since its inception.

The extent to which the FNC S&T business environment was conducive to accelerating technology transition was explored in Chapters IV and V: Chapter IV provided details regarding the S&T "business environment" and Chapter V presented an analysis of the data collected. Appendix A provides the raw, unedited, FNC Process survey feedback data.

The issue of technology transition metrics for the FNC Process was addressed in Chapters III and IV, as part of the overview of the S&T and FNC Processes, as well as in the data collected and analyzed in Chapter V. In Chapter V, the data collected through personnel interviews and survey responses provided additional insight into how the FNC IPTs operate and their use of transition metrics. A number of significant technology transition issues were illuminated as a result of the data collected for this thesis. Appendix D provides a summary of measures of effectiveness metrics uncovered during the literature review for this research.

The extent to which the current DoN transition efforts offer an improvement over past efforts was discussed during the data analysis of Chapter V and in concluding remarks. Some of the problems in technology transition were found to be tightly coupled to our current acquisition system. Appendix C provides a summary of a few of the major issues typically encountered by the S&T community when attempting to transition a new naval capability to the warfighter in a more accelerated manner (as intended by the FNC Process).

2. Period of Thesis Relevance

This study covers the "initial implementation phase" of the FNC technology transition process. Although some projects were already underway the initial implementation phase of the FNC Process started formally with FY02 funding and continues across the FYDP through FY07. As my research was concluding a "second" implementation phase of the FNC Process was in the planning stages and, as the editing was being completed, was in the initial implementation stage.

3. General Observations

The issue of technology transition is a highly complex and difficult matter. As the literature review illustrated, the problem has been looked at for a long time and there have been no long lasting, quick fixes; no obvious, easy answers to the numerous issues uncovered. At a very basic level there are at least two fundamental approaches to the problem of realizing greater technology transitions; 1) a "top-down" approach where corporate policy is implemented in a "command and control" structure by management, and 2) a "bottom-up" approach where significant change is attempted at lower organizational levels and disseminated at the working level for maximum impact. An optimal solution would probably comprise an intelligent combination of these two approaches.

Regardless of the approach taken, the literature provides a wealth of independent but consistent analysis which support the notion that organizations succeed as a consequence of strong leadership and good people. Strong leadership provides the

organization with a clear vision and communicates goals and objectives. These organizations seek out, attract, and retain the best people for the jobs that need to be done. Equally important, they remove people that are not in the right job.

As the issues of technology transition were explored for the DoN, some very significant issues were exposed. The literature search conducted revealed that many of these issues are not necessarily new yet remain unresolved–a testament to their difficulty. One such issue is that of the general principle of governance and an organization's administrative capability. ONR is an administrative organization that has been chartered by Congress to foster and develop new technical capabilities for the DoN. Its effectiveness is directly related to its ability (or inability) to effectively administer its duties. As other government organizations have found, "Public trust in government depends on being able to deliver."[239]

Acquisition Reform initiatives have caused the DoN to rely heavily on an increasingly politically active "for-profit" organizational system for delivering the products its warfighters require for the defense of our nation. Over the years the devolution of technical administrative capability, authority and responsibility from government agencies to a nebulous network of contractors has turned our naval technology development capability into an ineffective and inefficient bureaucracy. Budgeting processes that may have worked for traditional bureaucracies are less effective when dealing with nongovernment organizations. Personnel systems designed to insulate government from political interference have had difficulty in preparing a workforce skilled in managing indirect government. It may not be so much that the Navy has mismanaged the S&T Program but that the Navy has chosen to manage the program through a vast network of contractors in order to avoid the political fallout which would result with stating the case for an expansion of the DoN. The use of contractors itself is not the problem but the government's inability to manage its contractors and, as a result, the programs it has the responsibility to manage.

Assessments of the DoN S&T Program have been critical over the years and, as indicated by the results of this research, the FNC Process is proving to be no exception to

[239] Kettl (2002), p. 17.

such criticism. Independent assessments of the DoN S&T Program by such organizations as the National Academy of Sciences have consistently reported a lack of systems analysis and a void in the DoN's independent technical assessment capabilities. Indeed, from the literature search there was no evidence found that such a technical assessment service is being provided to the Navy by any of its organizational entities.

For the DoN, and unique among the military Services, the Office of Naval Research was established by law in 1946 as a military research organization. It was originally planned as a (post-WWII) "stop gap" measure in anticipation of the creation of a larger civilian-led agency which would support basic research for all military S&T needs. Among other political issues of that time-period there was considerable military resistance to the establishment of such a civilian-led agency. In 1950 a much scaled-down, presidential-controlled version of Vannevar Bush's vision was enacted into law as the National Science Foundation (NSF). The scope of the NSF, however, differed greatly from that originally envisioned by Bush. As an example, NSF would not focus on medical or military research needs. It is relevant to note that with the exception of the Navy, with ONR having already been enacted into law, no other Service has been the recipient of a congressionally-created civilian-led research organization within their Service[240]. The civilian-military leadership tension, clearly evident in the early years through a documentation trail, still exists today.

From its very inception the fundamental "business model" used by ONR–to distribute resources among universities to conduct basic search[241]–has been the subject of criticism, even within academic circles. For example, only a short while after ONR was established James Conant, president of Harvard, wrote Vannevar Bush a letter questioning the approach being taken by ONR as well as the quality of the research being delivered in this manner:

> The gossip I pick up in academic circles, both here and in other colleges (through the respective presidents) is that there is a great deal of concern

240 DARPA, a Defense Department research agency, does not report through any of the military Services but reports directly to OSD.

241 Greenberg (2001), p. 48. At the time the ONR was formally established it had already established 177 contracts totaling $24M, a lot in 1946.

> about the way the Navy is pouring out money for so-called fundamental research. The recipients are glad to get it, of course, but are wondering why it is flowing in that particular channel, and rather suspect there is a joker somewhere. I have also heard that some of the grants are to very second-rate people in third-rate institutions.[242]

Regardless of the type of organization an extensive literature search revealed the single, most important, component of a highly effective, successful organization–whether civilian, military, non-profit or commercial–was a quality workforce. Repeat reference to this essential trait was found in references to documents from Vannevar Bush.

B. CONCLUSIONS

1. DoD Guidance

The research conducted for this thesis confirms a continued emphasis to operate government departments, agencies and organizations in a more cost-effective, efficient, "business-like" manner. At the OSD level there is a strong emphasis placed on the conduct of joint service operations, interoperability issues and achieving cost reductions. For OSD, the first two emphasis areas provide additional impetus for the third. Within the Navy, a military service component of OSD, the priority of emphasis areas appears to be in reverse order; the primary emphasis has been predominantly on realizing weapon system cost savings with less attention being given to the interoperability and less yet to other joint service operational concerns. This diametrically opposed emphasis area prioritization greatly complicates technology development efforts within the Navy. For the Navy the priority differences are likely due to typical "consumer-like" market forces and a desire by the Navy to maximize an immediate Return on Investment (ROI) for its naval (vice joint) warfighting systems. For the Navy, quantifiable naval ROI measures for weapon system cost savings are more easily realized, measured and recapitalized than those of such multi-service goals such as interoperability and joint operations. Naval systems are therefore understandably supported with a higher priority than joint Service technology development demonstrations and weapons systems. Nevertheless, as current warfighting operations make very clear, interoperability and joint service operations can

[242] Greenberg (2001). As quoted on pages 48-49.

be expected to be an increasing emphasis within the DoD and, presumably as a consequence of such high-level attention, increasingly within the DoN as well.

2. Business Comparisons

The government is not a business and, in spite of continued attempts over the past twenty years, has great difficulties emulating business operations in a significant way. The literature search uncovered significant differences in fundamental operating principles such as supply/demand, customer focus, and revenue generation that a meaningful detailed comparison is very difficult. In areas where useful comparisons can be made, administrative and business processes for example, the DoN's FNC Processes did not compare favorably to the results of successful businesses.

a. Strategy and Vision

One area of comparison is the absence of a clearly articulated Naval S&T strategic plan for its current operations as well its transformational initiatives. As has been already observed by the GAO, "The need for a strategic plan when attempting major organizational and operational changes, such as those the navy is undertaking, has also been long recognized in the private sector as a best business practice."[243]

b. Personnel

As the literature attests, more than any other factor the quality of personnel has the most predominant impact on the effectiveness of an organization. Literature surveyed substantiated that high quality personnel can overcome even serious process shortfalls. Because the emphasis of the FNC Process was to transition new warfighting capabilities to the operational forces in a much accelerated manner, the FNC Process was designed around an Integrated Product Team (IPT) approach. This approach, it appears, was based on the understanding that ONR personnel (i.e., scientific researchers), although responsible for the execution of DoN BA1 through BA3 resources, were not necessarily skilled for the variety of tasks required by those Budget Activities–even more so when required in an accelerated timeframe. In response to these additional management needs ONR has brought in a community of contractors, detailees and

243 Military Transformation: Navy Efforts Should Be More Integrated and Focused. (2001, August) GAO-01-853. p. 6.

Interagency Personnel Agreement (IPA) personnel to handle some of the immediate administrative and acquisition-focused tasks. This increased workforce has, however, reduced the level of S&T resources available and generated additional external criticism.

c. Integrated Product Teams

The use of an Integrated Product Team (IPT) construct to manage the FNC program development responsibilities–a core component of the FNC Process–is a management structure which was not found to be widely used within industry, certainly not in the manner implemented by the Navy. There was no significant reference to such an organizational structure for the business community found in the literature search. In the manner implemented by the FNC Process the IPTs consensus-based management structure dilutes authority, complicates the decision-making process and generally slows down the technology development cycle.

d. Investment Metrics

In contrast to the commercial business sector the Navy has been using very few useful economic investment metrics to guide investment decisions. A significant effort has been devoted to “resource allocation” concerns but very little has been done regarding quantifying the ROI for investments already made. Many of the most common business environment performance metrics and market indicators surveyed as a part of the literature search for this thesis were found either to bear no direct investment comparison or were not in use by the DoN. In contrast to the DoN, a significant amount of work has been done by other Government agencies (for example, NIST) and economists with respect to these types of metrics.

The lack of useful metrics and performance indicators does not mean that DoN S&T investment decisions are wrong. What it does mean is that absent useful metrics to guide the investment decisions the decisions are being made with less confidence and with considerably more risk.

e. Management Reporting Structure

Although examples of corporate management terminology and organizational structure were found to have been transferred to the Government sector (i.e., the reference to a “Board of Directors”) such correlations were found to be very

weak and without substance. Such terms appear to be used in name only and have not been substantiated by formal and meaningful organizational changes. Significantly, there was one critically important relationship–the CNR's dual-reporting relationship to the CNO and to the ASN(RDA)–where a reasonable equivalent could not be definitively found in the commercial sector at all.

3. S&T Program

Historically, the Navy's support of the need and utility of new technology development activity has been mixed. The lackluster support of technology development on the part of the Navy appears to be due mostly to a low perceived ROI on the resources invested. The long-range view of S&T was not viewed as effective; the DoN saw very little product for their $1B+ annual investment over the years.

There has been a large turnover in ONR personnel over the past few years. This turn-over possibly allows the opportunity for increased flexibility in program content but is not making the process more efficient. Increased involvement at the OSD level appears to create new problems as a result of directed mandates without the resources to execute these mandates since (DoN) program execution responsibility does not reside at the OSD level.

A disturbing observation regarding the DoN S&T Program is the lack of positive Congressional support of the program as evidenced by the resources provided within the context of current wartime operations. The S&T Program was visibly implementing program structure and planning changes when the terrorist attacks occurred but were largely unaffected by the resulting Congressional POM programming and appropriation actions (excepting unplanned congressional plus-up activity). This disregard of the existing DoN S&T account is an indication of a lack of confidence by the Congress regarding the management of the S&T account by ONR.

a. Investment Level

In comparison to the corporate sector (for example, pharmaceuticals) the literature appears to confirm DoN S&T investments are disproportionately low. The current DoN S&T investment level, roughly at 2% of Navy TOA, continues to fall

significantly below the levels suggested by OSD guidance (3% of Navy TOA). There seems to be little hope for change since increases to the DoN S&T account (BA1-BA3) would necessarily come from other accounts (BA4+) within the DoN RDT&E line.

From a budgeting perspective the DoN S&T account is considered a "level of effort" program within the larger DoN resource allocation process. One reason for the Navy's technology investment portfolio being funded as a "level of effort" for budget purposes is because an S&T performance model does not exist at the OPNAV level, as is the case for other investment components of the DoN budget. Without an accurate performance model there is no means through which changes to the DoN S&T account could be iterated in order to assess the resulting change in S&T product output–to effectively determine the ROI on the investment changes which might be under consideration. As a result there is no quantifiable way senior Navy leadership can assess the benefits they receive from current investments or quantify any changes that might occur through funding changes to that account.

b. Program Imbalance

Although implemented as an attempt to realize a more appropriate balance of the short-term needs of the Navy as compared to the long-term needs, the recent restructuring of the S&T account has actually created a greater imbalance in the S&T account because of the impact the restructuring has had on the BA2 (Applied Research) efforts. Breaking the three traditional S&T categories (BA1: Basic Research, BA2: Applied Research, and BA3: Advanced Development) into two new categories (D&I: Discovery and Invention, and E&D: Exploitation and Delivery) has created a void in the BA2 category because half of the BA2 resources have become directly aligned with a specific FNC and are, therefore, unavailable for use. The BA2 category is critically important to S&T since it serves as a bridge between the Basic Research (BA1) advancements and the Advanced Development (BA3) efforts for the Navy.

c. Reporting Relationships

The dual reporting relationship of the CNR–on the one hand as the S&T OPNAV N091 resource sponsor reporting to the CNO and concerned with the short-term warfighting needs of the Navy and, on the other hand, as the CNR reporting to the

SECNAV and concerned with the long-term research and innovation needs of the Navy–appears to complicate matters further. Such a reporting relationship forces the CNR to "serve two masters" at once and, in so doing so, trade-off issues and concerns from one end of the S&T spectrum for those at the other end of the S&T spectrum. These compromises are being made in an environment that has become increasingly politicized over the years–as evidenced by the increasing influence on the S&T account through congressional plus-ups–while offering the CNR very little discretionary latitude to pursue possibly more innovative approaches to immediate warfighting needs. All-in-all, the resulting S&T research and development environment has become very difficult and demanding, at best.

d. Reporting of Results

The S&T community further exacerbates a difficult situation and does itself a disservice by not being able to articulate a convincing return on investment (ROI) for the resources it manages and executes. There is no consolation in the knowledge that the literature overwhelmingly supports the notion that describing the S&T ROI is an incredibly difficult problem and one that is common to many organizations within the government and commercial sectors.

e. Congressional Oversight

The rise in the number and amount of congressional plus-ups provides an indication of the level of outside dissatisfaction with the S&T process. Whether for purely political purposes or because they feel the S&T program and processes are flawed, technologists appear to be doing an "end-around" of the S&T process by going directly to their Congressional representatives -- and this trend is increasing. If sufficient additional resources are not provided to the S&T account to pay for these congressional interest items the impact on the S&T account, and transition planning activities, can be substantial. The continued declining DoN S&T budgets do not appear to support the notion that the Congress is satisfied with the performance of the DoN S&T investment portfolio.

f. Coordination

The importance of effective coordination is seen throughout this thesis. The administration, research and development of highly complex science and engineering

projects require robust coordination activity to be successful. As was pointed out in the literature search, the real metric of effective administration processes is the proper coordination of required activities. "No problem is more central to administration than coordination."[244] Effective coordination will allow responsibilities to be shared among administrators at different agencies, at multiple levels of government, and among nongovernmental partners. The more managers rely on networks to reach the various naval "customer" communities, the more they need to coordinate their activities in order to be successful.

From the survey responses the level of coordination within the FNC Process was shown to be unsatisfactory and largely ineffective. There were exceptions but most respondents, across all stakeholder communities, expressed dissatisfaction with many of the activities that are typically used for the proper coordination of activities. As the FNC Process matured and the responsibility to manage the FNC projects became more broadly shared in order to secure transition agreements, devising effective coordination strategies has become an increasingly difficult problem. There was no evidence found which showed that this coordination problem was being addressed in any way, however. There is a small[245] SYSCOM liaison staff but the primary FNC coordination activities are done through the program managers for the specific programs being funded.

Part of the reason for this lack of coordination activity is, of course, due to the additional cost of any such coordination effort. At a time of declining budgets shouldering the cost of an activity that does not provide a clear, tangible product may be resisted. The literature search did reveal that a common problem encountered by collective action groups was paying the added costs of coordination; the recommendations of past research suggested these costs should never be left out of the business model. These were identified as "the costs of communication among group

[244] Kettl (2002), p. 163.

[245] There is a single NAVAIR, NAVSEA, SPAWAR, and CNET SYSCOM liaison representatives in the SYSCOM liaison office as well as a separate NLCCG Warfare Center liaison. Each of the SYSCOMs and Warfare Centers have a larger number of technical 'detailees' working specific projects at ONR on a limited rotational basis and as necessary. The NRL and MC SYSCOM liaison function is done differently and are considered to be more tightly integrated throughout ONR.

members, the costs of any bargaining among them, and the costs of creating, staffing, and maintaining any formal group organization."[246]

g. Long-Range Planning

At the current time there does not appear be any effective means through which the DoN can investigate truly transformational approaches to naval warfighting. The redistribution of the DoN S&T account (which created the FNCs) has shifted focus to the short-term, low-risk, incremental technology development activity at the direct expense of those development efforts needed to investigate operational concepts and technology options in support of longer-term naval warfighting concepts and operations. A steady increase in outside oversight has imposed demands on a shrinking pool of S&T financial resources. There was no direct linkage found between high-level (CNO, SSG or other) naval think tanks, project planning and technology demonstration efforts. As far as could be ascertained there is no naval group specifically chartered to do such technology option assessments in order to explore, examine and raise critically important technology implementation issues to an appropriate DoN level for consideration, and resolution. The literature search shows this to be a long standing problem within the DoN and, as the results of this research illustrates, the situation has not improved significantly over the last 50 years.

4. The Future Naval Capability Process

The DoN's FNC Process was implemented in an attempt to achieve a "better" balance between long-term objectives and short-term naval operational needs. Although a direct link was not confirmed in the literature search, the FNC Process appears to be a reasonable response to earlier criticisms of DoD technology insertion processes. In particular, the FNC Process appears to be a thoughtful response to a "Team 6" Process Action Team (PAT) study conducted for ASN(RDA) in 1998. The FNC Process might even be considered as a reasonable response to earlier DoD desires for new "capability-based" technology insertion processes as well. Earlier defense studies recommended a

[246] Olson (1971), p. 47.

"capabilities-based process" for identifying warfighter needs, creating new technology options, developing innovative solutions, and delivering the new capabilities in an accelerated manner. The FNC Process, as envisioned and documented in the implementation paper trail, does appear to meet the major objectives of the desired criteria for these studies..

Ironically, reducing life cycle costs–although clearly a near-term naval need and a consistent warfighter high priority request–do not appear to have been a primary focus of the FNC Process. The FNC documentation reveals that several of the IPTs that focused on these types of technology issues–Total Ownership Cost, Capable Manpower, and Expeditionary Logistics, for example–were among those most aggressively "targeted" FNCs for resource allocation reductions[247]. The reasoning for such apparently contradictory behavior appears to be due to a conflict in priorities and objectives among the operational warfighter, acquisition and S&T communities which was not easily resolved by the IPT structure or at higher DoN levels. Such technical emphasis areas, although critically important and of immediate need by the warfighter, were nonetheless viewed as "low tech" developments that can be easily delivered by defense contractors through normal acquisition community processes. These same warfighter needs and requirements, however, ended up having a low relative priority for funding within the acquisition community and so have great difficulty getting resolved in an effective and timely manner.

a. Funding

The S&T Program budget was found to be approximately 2% of Navy TOA. The FNC component of the overall S&T Program was initially resourced at ½ the DoN S&T Program budget. As a result of a large number of programmatic reviews the resources allotted to the FNC Program were gradually reduced–by roughly 50% -- to its

[247] Indeed, to cite an example of such "targeting", the CM FNC was at one point under serious consideration for elimination (the allocation of zero resources) and was eventually moved out from the FNC Process structure effective for what I refer to as the "second implementation phase" of the FNC Process and just beyond the period of relevance for this thesis.

current level of approximately $500M.[248] The disruptions caused by repeated re-evaluations appear to have been substantial due to the number of projects involved (200+) and the level of investment of these projects. When the "ripple effect" is considered the net result was severely detrimental to the administration and continuity of the entire technology development process.

b. Investment Indicators

There was a general lack of investment indicators found in the documentation. Although there were significant attempts at implementing a business process approach to the IPTs through mechanisms such as "Business Plans" these plans did not provide additional information with respect to investment indicators. As far as could be determined the IPT made investment decisions using very informal investment indicators, if they used any at all.

c. Use of Integrated Product Teams

The IPT approach–central to the FNC Process–has been inadequate to provide the leadership and guidance needed, in the manner implemented. As process implementation guidance, senior-personnel interview feedback and process participant survey responses have all clearly indicated the IPT structure is strictly a consensus-based program approval board with minimal overarching (cross-FNC) integration, visibility and demonstrated interest. The data collected for this thesis has identified a variety of problems across all stakeholder communities:

(1) ***The OPNAV community***, as Chair of the IPT and responsible to establish the requirements for programs approved to deliver the desired future naval capabilities, has not been embraced the FNC Process in a meaningful way. The important issue of requirements (who generates) remains unresolved by the FNC Process. The quality of the requirements generated by OPNAV in the first cycle of the FNC Process was mixed. For all practical purposes the OPNAV community remained consumed with important and pressing budget and higher-level OSD issues to develop a

[248] Reductions effectively continue. This figure is before the removal of the Capable Manpower and Warfighter Protection FNCs from the "core" FNC portfolio. This action (removal of these two FNCs from the portfolio) is considered to have occurred following the period covered by this thesis.

consistent, focused, set of capability-based requirements for the S&T community to respond to.

(2) ***The S&T community*** has seen the FNC Process as a major disruption to their mission of researching and developing technology options to the DoN. The restructuring of the traditional S&T (BA1 + BA2 + BA3) account to a split-portfolio–D&I (Discovery & Invention) + E&D (Exploitation & Deployment)–approach. This fundamental redistribution of the S&T portfolio has caused a major shift in the focus and emphasis of the S&T activities towards much shorter-term development concerns at the expense of the traditional technology development planning approach. This restructuring has resulted in a void in the Applied Research (BA2) category which can be expected to greatly hinder future transition efforts if left unchanged.

(3) ***The Acquisition community***, the community which quickly embraced the process and was the most satisfied with the process (according to survey responses), has also expressed significant concerns with the process. Of primary concern to the acquisition community has been with regard to budget instability issues as well as a lack of awareness regarding how to introduce new programs into the FNC Process. Because of the emphasis on the need for transition agreements there has been criticism that the FNC Process has actually inhibited naval innovation by directing scarce S&T resources to current acquisition programs – using S&T resources to essentially ‘plus-up’ acquisition programs. Similar criticisms were that the FNC Process, through its transition agreements, has essentially ‘locked-up’ innovations throughout the FYDP even though many of those agreements might never be fulfilled.

(4) Without a doubt ***the Fleet/Force community*** has been provided a much greater visibility, and indeed in some cases demonstrated a sense of ownership, into new technology projects being developed to address fleet needs. The remoteness of the operational forces complicates the dynamics of the IPT approach, however. Although the distances involved do not rule out their effective IPT participation it certainly creates a much greater need on having the IPT operate effectively. The frustration conveyed through the survey responses indicates this community feels frustrated in their general inability to easily engage the IPT at a

meaningful (working) level. This community, the end-user and ultimate customer of the capabilities developed and delivered, expressed opinions that the FNC Process appears to be mostly lip-service and is not yet functioning effectively. Possibly in response to these frustrations there have been other, post-FNC Process, attempts to connect the S&T community to the needs of the operational forces[249].

Many of the problems discussed here are due to the ineffectiveness of the management (i.e., by IPT) approach embraced by the FNC Process. The IPT's consensus-based management-by-committee structure was not found to be used within the commercial sector. There was no evidence found to support the successful use of such a management structure outside of the government acquisition community. The wide variety of management and business references consulted for the literature review of this thesis provide no examples of such an approach being used by successful commercial operations.

Furthermore, the IPT concept implemented by the FNCs was not an accurate implementation of the concept as originally conceived by DoD and the acquisition community. There was no evidence of formal Working Group IPTs found anywhere in the implementation documentation or in any of the records examined. Through discussions with personnel informal working groups are known to have been formed for some of the IPTs. These discussions provide some evidence that indicates the more successful FNC's were those that appear to more closely align with the IPT approach as originally conceived[250]. Additionally, IPT membership behavior appears to have tracked well with many of the predictions of group dynamics from the fields of Collective Action and Game Theories found in the research literature.

d. Group Behavior and Collective Action

The experiences and feedback provided by the stakeholder community correlates strongly to the behavior predicted by researchers of group dynamics, collective action and game theories uncovered by the literature search. Theories of collective action

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[249] A closer examination of other such processes -- for example, ONR's "Tech Solutions" and ASN(RDA)'s "Rapid Technology Transition" programs – are beyond the scope of this thesis.

[250] From data provided during personnel interviews and returned surveys there is some reason to believe the OMCM and KSA IPTs operated more in line with original IPT guidelines than other FNC IPTs.

support the effectiveness of small decision groups over larger decision-making groups. The IPT construct, central to the FNC decision-making process, is consistent with this aspect of collective action theory. FNC Process participant experience, however, indicates the group behavior and decision dynamics were found to be highly complex and there was a high level of dissatisfaction expressed regarding the effectiveness and leadership of the individual IPTs and FNC decision-making process as a whole. This level of dissatisfaction indicates there is a need to analyze the construction of the IPTs more closely. Such an analysis is beyond the scope of this thesis. Without careful analysis, however, the experiences revealed by the literature search show there is little chance of success. The lackluster results of the FNC Process to date are fully consistent with the previous research performed.

e. Customer Focus

The participant survey and interview data collected reveal the lack of a clear and strong customer focus. Although "the fleet" was generally considered to be the customer this was not the case universally nor, when it was the case, was there a clear understanding as to who, exactly, was "the fleet." Most respondents struggled with a firm grasp as to who, specifically, the customer was.

The shift from a demonstration-centric process (very early in the FNC Process) to delivery-centric mandated the negotiation of very specific technology transition agreements. This shift changed the emphasis of the FNCs from developing new and innovative future naval capabilities to delivering evolutionary incremental upgrades to current acquisition programs of record. Stakeholder input from personnel interviews and survey responses reveal a low confidence level in the utility, accuracy and reliability of the TTAs and that some of these agreements are being generated mostly to appease the process.

f. Customer Satisfaction

Data collected from personnel interviews and survey responses clearly indicate that stakeholders of the FNC technology transition process remain dissatisfied with the performance and results demonstrated to date. Much of the ineffectiveness might be attributed to the absence of an effective customer-focused "business model"

such as is more commonly used within the commercial sector. The lack of such a "business model" appears to be a consequence of the fact that the DoN S&T account needs to service the entire DoN community. This scope requires the DoN S&T account to respond to a very large number of potential naval customers–each with different needs, requirements and risks. The S&T community receives more requirements guidance than they can support and manage programs with widely varying levels of maturity and risk. As a result they are regularly forced to make internal tradeoffs in order to provide the best value while complying with DoN fiscal constraints.

g. Reporting and Accountability

Senior leadership interviews and stakeholder survey data substantiated a clear perception that the S&T Program does not deliver and there is little accountability of the investments being made. This perception stems from a lack of reporting that is surprising from the research community and would probably not be tolerated in a competitive commercial environment. ONR does not typically publish technical reports on the progress or accomplishments of the projects they fund nor do they release annual reports or other information to the defense community. This void of defense community communication exchange contributes greatly to the perception that ONR investments are not important or produce significant results. ONR needs to be more open in their reporting and investments. In light of focus on the corporate accounting an increased emphasis on full and open disclosure of the FNC program investments, and technical progress can be expected to increase.

h. Project Entrance-Exit Strategy

In spite of best intentions the FNC Process remains limited in scope having neither a widely recognized entrance strategy (program initiation) nor a well-understood exit strategy (program termination or transition). The process has not been supportive of the most obvious exit strategy–the demonstration of a future naval capability as a part of a larger technology development process such as the OSD ACTD process.

i. DoN Integration of the FNC Process

The MC approach to the FNC Process was a clear success. Of all the Naval Systems Commands, the Marine Corps System Command clearly stands out as

being the most strongly integrated with ONR's S&T planning processes. As a result of such a strong organizational integration emphasis, the MC appears to have benefited significantly, possibly even disproportionately, from participating in the FNC Process. Numerous stakeholder survey comments lament what appears to them to be a disproportionate clout by the MC community. The strong MC involvement is the result of a direct and concerted effort to involve the MC community in DoN S&T planning activities, however, and is the related to a number of ONR-MC technology planning and investment agreements which were established prior to the FNC Process. These agreements resulted in the Deputy Commandant of the Marine Corps (CMC) being designated as the VCNR and the unprecedented movement of MC billets to ONR from MC facilities at Quantico, VA. Although there is a liaison function no equivalent highly-integrated working relationships were found to exist with other naval Systems Commands (NAVAIR, NAVSEA, SPAWAR, etc). To their credit the MC have been highly effective in leveraging "blue dollars" across the spectrum of FNCs while also resisting the allocation of "green dollars" from being used for DoN objectives which do not specifically address MC priorities. The MC success in influencing IPT investments is emphasized by the comparative demonstrated lack of priority and emphasis placed on the FNC Process by the military component of the OPNAV community. The observed MC community behavior, incidentally, appears to be consistent with the behavior predicted by group behavior and game theories found in the literature search.

j. Joint Technology Development

The FNC Process has not been supportive of OSD joint service technology planning and development processes; specifically the ACTD process. With the increasing joint emphasis this DoN S&T linkage to joint operations is becoming a more visible liability and illustrates a discord regarding the governance of technology development authority within the DoD. Current wartime operations have raised the general awareness that the U.S. does not deploy individual services to conduct major operations–it deploy's a joint force. DoD senior level leadership has repeatedly articulated their belief that the power of a joint force greatly exceeds the sum of the separate service capabilities. As such providing technology options which will enhance our joint warfighting capabilities through a more effective use of our Naval forces is

becoming increasingly essential. Ironically, of all the Defense Services and Agencies the DoN is organizationally in a position to develop and demonstrate joint interoperability more easily than others due to the diverse nature of its constituent components[251]. The DoN cannot hope to contribute meaningfully to joint operations if its own technology development processes do not emphasize those same objectives.

The drive towards joint operations is so strong, and so important, that it should not be ignored. If the DoN fails to address the interoperability and joint operational issues in a meaningful way there is a risk of the DoN's S&T organization being restructured due to lack of fleet impact and perceived technological irrelevance. Such an action would simply be a "business decision" based on the demonstrated low return on investment. One possible action might be to merge the DoN S&T technology development process model with that of another Service as a first step in achieving joint operations. Such an action becomes a real possibility due to the fact that the DoN organizational leadership is appointed at the joint level and military leadership provides little stability due to the frequency of military and civilian rotational assignments. This DoN senior military organizational rotation process, coupled with the fact that the DoN S&T senior civilian leadership has completely turned over the past few years, means that there would be very little resistance to such additional restructuring of the DoN S&T process by DoD, Congress or both. In my view such a Defense-level organizational change would be detrimental to the DoN mission and would adversely impact our future Naval operational readiness. Such an action would not appreciably benefit our Naval warfighter or, I believe, our national defense infrastructure.

k. Outside Oversight

Dissatisfaction with the output of the S&T Program over the years has resulted in increased outside oversight and this trend can be expected to continue. The FNC Process itself, as detailed in Chapter IV, was a compromise to the investment process brought on by an increase in high-level oversight of the S&T Program. This

[251] The diverse spectrum of naval components would include SPAWAR (satellites, IT, communications), NAVAIR (aviation), NAVSEA (submarines, surface ships) and the Marine Corps (ground forces). These components, spanning warfighter operations from space to the ocean bottom and everything in between, contain the essential interfaces required for successful Joint force operations at the current time.

increased oversight was the result of dissatisfaction in the perceived S&T Program output. There are other indicators, such as the greatly increased number and amount of congressional 'plus-ups' to the S&T account, that provide additional independence evidence in support of an increasing amount of outside influence and oversight. In fact a very high percentage – fully one third – of the DoN S&T Program now comes from these congressional actions. This outside influence greatly limits the flexibility of the S&T managers by reducing the level of discretionary funding. Such constraints have the potential effect of producing a much more disjointed investment portfolio due to the limiting (for example, "stove piped") nature of the resulting project selections. This outside influence can be viewed as a consequence of a lack of confidence in S&T Program Managers to execute S&T resources in a reliable manner.

C. RECOMMENDATIONS

1. Business Operations

Every effort should be made to continue to improve the accountability and execution of general good business and research practices. Examples of typical business practices would include the preparation of annual portfolio investment reports, the recruitment of a more professionally diverse workforce and a much greater outreach to other defense and commercial communities to encourage a greater awareness of technology opportunities and to facilitate increased personnel technical networking. Examples of typical research practices would include the reporting of technical results, providing feedback to appropriate communities and greatly increasing–rather than decreasing–communication and coordination activities within the stakeholder communities. In many cases ONR's execution and follow-through on these types of activities was considered to be poor which contributes to programmatic uncertainty, causes confusion and generates an atmosphere of mistrust which, in turn, ultimately undermines future partnering activities.

2. S&T Program

It is recommended that a comprehensive S&T "business model" be rigorously discussed, an agreeable model be developed and then articulated throughout the Congress/DoD/DoN communities in order to win stakeholder support. Included as a component of such a business model would be appropriate economic indicators and useful performance metrics. One of the components of such a business model would be a DoN S&T Strategic Plan that would clarify appropriate usage of DoN S&T resources, and support senior level goals and objectives. In accordance to a typical business perspective, the entire S&T investment portfolio will need to focus on the Navy's vision, concepts and problems in a more highly coordinated and tightly integrated manner.

The S&T account should be resourced at the full 3% levels established by OSD. It is suggested these resources be distributed equally among the BA1/2/3 S&T portfolio budget activity accounts. As part of its S&T Strategy ONR shift their emphasis to perform a DoN S&T Assessment and Advisory role for the entire DoN and use its account to support such an advisory role.

As a fundamental change to the way the DoN conducts our S&T business the following investment approach is offered for consideration:

a. Basic Research

The DoN Basic Research (BA1) investment portfolio would investigate those concepts embraced by the CNO and supported by high-level organizations such as the Naval War College, Naval Studies Board, Strategic Studies Group, Naval Warfare Development Command, Naval Postgraduate School, etc. The BA1 account should initiate academic research programs that support a large number of fundamental concepts at appropriate resource levels. There needs to be a direct linkage between DoN Basic Research programs and DoN long range operational guidance, vision, concepts and missions. There should also be an appropriate level of support for advanced concepts of a possible joint service nature. This component of the overall DoN S&T investment portfolio would represent the Basic Research component of the DoN S&T budget and would best be administered and executed by the Office of Naval Research in

collaboration with the most appropriate external naval "think tank" organizations mentioned. Such an arrangement would foster a more integrated coupling among our national civilian academic infrastructure, our military schools, and the NRE community laboratory and research centers.

b. Applied Research

The DoN Applied Research (BA2) investment portfolio should focus on developing a large number of advanced technology 'options' based on review of the maturity and usefulness of relevant BA1 investigations and as applicable to overarching DoN future concepts and visions developed by the NWC, NWDC as well as the CONOPS developed by the various Naval and Joint Forces Commands. This component of the DoN S&T investment portfolio should take full advantage of the NRE personnel and expertise within the various Systems Commands, Navy laboratories and Warfare Centers, Logistics Support Activities, Depots, etc., regarding the development and operational integration of these future technology concept options. This component of the S&T portfolio would represent the Applied Research component of the DoN S&T investment portfolio and would best be administered and executed by the Office of Naval Research in close collaboration with the NRE Community (SYSCOMs, Warfare Centers, FFRDCs, etc.). In order to promote the development of the large number of advanced technology options required for a robust S&T program the NRE community should be entrusted with the authority and flexibility to administer the BA2 funds with wide discretion.

c. Advanced Development

The DoN Advanced Development (BA3) investment portfolio should focus on selecting a few of the applied technology "options" developed within the BA2 portfolio and implement the most desirable technology options on weapon system platforms for capability demonstration, evaluation, and performance verification. These technology options would be selected in accordance with the overarching DoN future naval capability concepts and visions embraced by the DoN. There are two exit strategy paths envisioned for BA3 projects; projects which target existing navy platforms would be developed as specified through a transition agreement under the management of an appropriate FNC IPT. Other more innovative and less traditional projects and concepts

that do not align with current DoN platforms or programs would be developed in parallel but under a different management structure. It is reasonable to expect a number of these projects would be focused on joint high-priority operational issues. Both types of BA3 projects would culminate in advanced technology demonstrations of system components that comply with operational requirements and CONOPS developed by the appropriate centers and Commands. This component of the S&T portfolio should take full advantage of the facilities and personnel expertise across the NRE "supply chain" for the systems engineering, operational integration, and logistics support of these future technology weapon system concepts. This component of the S&T investment portfolio would represent the Advanced Development component of the DoN S&T portfolio and would best be administered and executed by the Office of Naval Research in collaboration with the DoN Acquisition PEO's and industry partners.

d. Technology Demonstrations

A small number of high-priority BA3 programs should be selected for joint warfighting capability demonstration by operational fleet forces as Advanced Concepts Technology Demonstration (ACTD) candidates. These programs would represent the DoN contribution to joint warfighting capability demonstrations for the DoD. These advanced concept demonstrations would provide the (multi-service) fleet forces an opportunity to apply a variety of well thought out and fully coordinated naval technology advancements integrated with capability demonstration systems from other services and Defense Agencies as viable options to the Joint Forces highest priority problems. This approach would provide the warfighter a wide selection from which to choose the most appropriate solutions to the highest priority warfighting problems and new concepts desired. Upon successful completion of objectives a select number of these advanced technology solutions would then fully transition into operational use by the Joint Forces through the appropriate Services and normal acquisition channels. This component of the technology transition process currently extends beyond the direct control of the DoN and would best be administered and executed jointly by the Office of the Secretary of Defense and the appropriate service(s) and Defense Agencies (the Office of Naval Research for the DoN component, etc.).

e. Discretionary Authority

In order for the DoN to respond to unanticipated contingencies more effectively a small but reasonable portion of the entire DoN S&T account (BA1/2/3) should be reserved for ONR discretionary use as deemed most appropriate. Such discretionary flexibility would be useful in emergency situations and would function as a very useful "buffer" for the remaining portion of the S&T portfolio. Such a buffer would be very beneficial from a program management aspect and should help to stabilize the DoN's technology development process. In accordance with other similar recommendations a complete and accurate accounting of the actual uses of the resources should be made on an annual basis.

3. Organizational Changes

Two of the primary problem areas with the S&T Program have been the inability of the military to establish quantifiable requirements and the dual-reporting chain for the CNR. The difficulties in defining program requirements was found to be a long-running, historical problem for the Navy that defies easy solution and continues to plague the DoN today.

In an attempt to address these two problems a new reporting relationship structure is proposed. The new organization would separate the military and civilian responsibilities to clarify roles and responsibilities more distinctly and assign responsibilities more appropriately.

a. Military Relationships

For the military, the senior flag officers' role would change from Chief of Naval Research to Chief of Naval Requirements with the responsibility to coordinate the generation and quantification of priority naval requirements across the spectrum of the DoN. The OPNAV requirements role is central to the FNC Process but the inability of OPNAV to execute its duties has been a major hindrance to the success of the FNC Process. In this new role the CNR would be responsible to define the appropriate technology demonstrations for the technologies under development and would have the responsibility to coordinate warfighting requirements definition and priorities across the

DoN but limited fiduciary responsibility. In such a capacity the CNR should, by whatever means deemed most appropriate, establish much closer collaboration agreements with other Navy stakeholder organizations in a manner similar to the arrangements that have been demonstrated so successfully with the Marine Corps. As a suggestion, it is envisioned the CNR would maintain a collaboration military staff consisting of the following suggested membership:

- VCNR (MC) – Marine Corps. Responsible to coordinate naval requirements from the Marine Corps community. This position already exists and is a dual-hatted flag officer from the Marine Corps Combat Development Command (MCCDC). This position would also coordinate with CNO (N75) and personnel would be assigned on a (2-3) year rotational basis.
- VCNR (Space) – Responsible to coordinate naval requirements from the SPAWAR community (IT, communications, etc). This position would be a dual-hatted flag officer representative from the Space and Naval Warfare Systems Command on a (2-3) year rotational basis.
- VCNR (Air) – Responsible to coordinate naval requirements from the aviation community. This position would be a dual-hatted flag officer representative from the Naval Air Systems Command or the CNO (N78) on a (2-3) year rotational basis.
- VCNR (Surface) – Responsible to coordinate naval requirements from the surface community. This would be a dual-hatted flag officer representative from the Naval Sea Systems Command or the CNO (N76) on a (2-3) year rotational basis.
- VCNR (Subs) – Responsible to coordinate naval requirements from the submarine community. This position would be a dual-hatted flag officer representative from the Naval Sea Systems Command or the CNO (N77) on a (2-3) year rotational basis.
- VCNR (Intelligence) – Responsible to coordinate naval intelligence technology requirements across the DoN community. This position would be a dual-hatted flag officer representative from the Office of Naval Intelligence on a (2-3) year rotational basis.
- VCNR (Personnel) – Responsible to coordinate naval personnel requirements across the DoN community. This position would be a dual-hatted flag officer representative from the Bureau of Naval Personnel on a (2-3) year rotational basis.
- VCNR (Logistics) – Responsible to coordinate naval logistics requirements across the DoN community. This position would be a dual-

hatted flag officer representative from the Naval Supply Systems Command or on a (2-3) year rotational basis.

- VCNR (Medical) – Responsible to coordinate naval medical technology requirements across the DoN community. This position would be a dual-hatted flag officer representative from the Bureau of Medicine and Surgery on a (2-3) year rotational basis.
- VCNR (Joint Ops) – Responsible to coordinate joint program requirements for the DoN community. This position would be a dual-hatted flag officer representative from the Joint Forces Command on a (2-3) year rotational basis.
- VCNR (Special Ops) – Responsible to coordinate Special Operations program requirements for the DoN community. This position would be a dual-hatted flag officer representative from the Special Operations community on a (2-3) year rotational basis.

Certainly there are issues with the recommended approach suggested here. Such an oversight body, for example, may prove to be difficult to manage as a result of the relatively large size of the group, as the research in group theory and collective action predicts. This drawback is somewhat countered by our experience with the positive results achieved by the Marine Corps as they integrated their S&T workforce with ONR: a highly integrated workforce has been demonstrated to be very effective for the Marine Corps.

b. Civilian Relationships

On the civilian side a Director of Naval Research and Development (DNRD) would be responsible for developing programs to address the military requirements developed by the CNR. The DNRD would be responsible to interface with the Congress regarding resourcing the technical component of the DoN S&T portfolio. The DNRD should, by whatever means deemed most appropriate, establish closer collaboration agreements with other national stakeholder organizations. As a suggestion, it is envisioned the DNRD would maintain a collaboration staff consisting of the following suggested membership:

- Chief Scientist – Ensures technical quality of all work being funded. This would be a senior technologist or administrator serving on a rotational basis (5 year max).

- Director of Research – Responsible for the BA1 portfolio. This would be a senior administrator selected from the US University system on a (2-3) year rotational basis.
- Director of Applied Research – Responsible for the BA2 portfolio. This would be a senior technology development manager taken from one of the NRE organizations on a (2-3) year rotational basis.
- Director of Advanced Development – Responsible for the BA3 portfolio. This would be a Senior Manager from Industry performing a civic service on a (2-3) year rotational basis.
- Director of Acquisition Relations – Responsible to coordinate transitions into DoN acquisition programs. This would be a senior member from a PEO on a (2-3) year rotational basis.
- Director for Joint Operations – Responsible to coordinate naval development programs into a joint service demonstration. This would be a senior representative selected from another Service on a (2-3) year rotational basis.
- Director for Legislative Operations – Responsible to coordinate naval development programs with the legislative branch of Congress. This would be a senior representative selected from the legislative community on a (2-3) year rotational basis.

Such a staff would provide a much higher degree of awareness, communication and coordination of the DoN S&T portfolio among the major stakeholder constituents. In this organizational architecture the DNRD would have technical and fiduciary responsibilities.

c. Congressional Interface

In response to the increasing influence of congressional actions on the DoN S&T account a more proactive management interface should be established in order to interface more effectively and instill increased confidence in ONR's ability to execute programs and resources more reliably.

4. FNC Process Changes

The use of S&T resources to "plus-up" current acquisition programs, used as the primary technology transition mechanism for the FNC Process, is an inappropriate use of scarce naval S&T resources and should not continue at current levels. As the FNC

Process continues to be reviewed and evaluated within the DoN, consideration should be given to additional process changes that would take more of a “business” approach–one that provides a more direct and tangible link to the warfighting customer–to the technology transition process. In response to guidance by OSD to address interoperability and joint service warfighting operational needs it is recommended that as new FNC investment areas are considered an entirely new approach be considered on a test case basis. Such a test case would allocate an appropriate level of FNC resources ($50M/year over the FYDP) to establish a single joint FNC intending to focus on joint operational needs.

This joint FNC would remove OPNAV from the Requirements-establishment position (i.e., Chair of the IPT) but leave them with their (financial) Resources responsibility. Establishment of the joint FNC capability program requirements would be the responsibility of the customer, a designated Combatant Commander (CoCOM) or Joint Task Force Commander who would take ownership of the joint FNC Process, program development and capability demonstration. Such a process change is desired since it is the CoCOM, or Joint Task Force Commander, who has the responsibility to integrate service capabilities into a coherent joint force.

The Joint Capabilities Integration and Development System (JCIDS) supports the capabilities-based technology transition process, from a Joint Forces level. JCIDS appears to be a customer-focused, top-down process that would generate Joint Forces Enabling Capabilities (ECs) that support the Functional Capability Boards (FCBs). A joint FNC would be aligned with the ECs and resource programs to respond to the EC’s and the applicable FCBs.

This approach would help to focus a number of current S&T investments on a specific, identifiable customer. For example, DoN S&T Science Advisors, already stationed at several Joint Force Commands would provide local S&T connectivity and help facilitate dialog between Command personnel and the applicable components of the NRE.

Changing the FNC Process in such a way should help to focus all joint FNC efforts to respond to an identifiable customer's joint warfighting capability needs. A significant level of investment would be dedicated to transitioning new capabilities to an operational joint force in a much more organized, coordinated, efficient and effective manner. Doing so would demonstrate the DoN's ability to participate fully and contribute meaningful naval-focused technology solutions to our joint forces in a much more rapid manner.

5. Budget Stability

The entire S&T Program, certainly the FNC component of the S&T Program at a minimum, should be funded at an appropriate resource level and, once this has been done, isolated to the maximum extent possible from serious funding instabilities over a designated performance time frame (i.e., the FYDP).

D. SUGGESTIONS FOR FUTURE RESEARCH

1. Workforce Composition Analysis

There is a wealth of literature available that researches successful organizations and what it takes to be successful. Even with this abundance of resource material the ability to overcome organizational obstacles remains elusive. Although there were very clear indications found in a variety of resources that the people are the determining factor in successful organizations there was very little literature found on an analysis of the composition of successful organizations (corporate or government) from a human resources perspective. It is quite possible that many of our organizations falter because of poor workforce utilization practices and an inability to move personnel to more appropriate positions and responsibility or eventual termination, if necessary. A comparative detailed study of the workforce compositions of (successful and unsuccessful) select commercial, non-profit, military and civilian organizations would be insightful and valuable.

2. IPT Decision Dynamics

The literature search provided only a glimpse at some of the past research conducted on group behavior, game theory, and collective action issues. The experience of participants in the FNC Process suggest that additional research is needed to architect an IPT which will be able to accomplish the group decision-making objectives desired. An examination of previous thesis' and other relevant research material revealed not much was known about the group dynamics, process governance and decision making in the acquisition communities IPT construct as was being implemented by the Navy for the FNC Process. Although the field is rich with research of a general nature, the requirements for core group effectiveness and the dynamics of the relationships among group members, non-core group members and non-members are not fully understood by those within the DoN for the IPT group decision-making model. A greater understanding of these aspects of group theory is essential and would be a valuable contribution for the formation and management of future IPTs.

3. FNC Transitions

In spite of the enormous effort in restructuring the DoN S&T portfolio to apply resources to meet the near-term needs of our operational forces, there is a clear perception that these changes made have had little to no actual impact on the warfighter or the advancement of any future naval warfighting capabilities. Arguably, the FNC Process was too new to accurately assess the results of its initial implementation phase (POM02 project selections) but these projects should be tracked and an analysis of the IPT transition track record should be undertaken.

4. Supply Chain Utilization Cost-Benefit Analysis

There was sufficient evidence found in the literature that proper utilization of a sector's "supply chain" is essential for effective and efficient operations for the commercial sector. The laboratory, military research center, and university components of the Navy's technical resource enterprise – the Naval Resource Enterprise – continues to be underutilized by the DoN. This trend to underutilize our laboratories has not been

limited to the Navy but is occurring nationwide and is severely limiting the utility and effectiveness of the affected laboratories and research centers at a time when there are a number of national security and science and engineering educational shortfalls starting to attract national attention. An accurate cost-benefit analysis of the utilization of the DoN NRE components would be very valuable.

5. FNC Participation Costs

A more complete cost-benefit analysis regarding the costs of participation in the FNC Process is another area for study. What is the full cost of IPT membership? What affect would the assessment of annual fees have on FNC program participation? What are the R&D "extraction" costs? What are the R&D implementation costs? How can these costs be measured? How can the value of member benefits be quantified? How do R&D costs vary across an IPT portfolio and across the NRE community? At what point would the cost of serving member needs exceed their fees? Although the precise measurement of these metrics would be difficult to accomplish a greater understanding of the critical variables would prove very useful.

6. Cost Analysis Model

The primary assumption of this thesis was that continuously rising development, acquisition and life cycle costs have contributed greatly to the push by DoD to require the Navy to operate more "like a business" in the hope of recapitalizing any cost savings realized. It is not clear, however, that the Navy has a sufficient grasp of the various contributing components to a total cost equation for a weapon system or even a clear description of the individual components that contribute to such a cost equation. It would be useful to develop an accurate DoN cost analysis model for weapon systems (submarines, satellites, aircraft, etc). Such a model(s) would prove beneficial for the development of a business case to support investment decisions in an environment of rising costs.

7. Time-To-Market

The desire to transition new technical capabilities to the warfighter in a much more rapid timeframe was a major impetus behind DoD's many acquisition reform initiatives over the past twenty years. This emphasis was also a contributing factor in the restructuring of the DoN S&T account and the implementation of the FNC technology transition process. Such reform policies included the mandated use of commercial business practices and the devolution of civilian-military technical design authority to the commercial sector as being necessary to deliver products of lower cost and higher quality in a much more accelerated manner (because of superior commercial business practices and market efficiencies). In spite of the substantial measures undertaken there is evidence that DoN continues to fail to realize the benefits desired. Military weapons systems still take many more years to achieve IOC than initial plans called for at development costs which continue to climb and are measured in the billions of dollars. A study of the issues, experiences and relevant factors involved in accelerating the time-to-market (TTM) for DoN weapons systems would be very worthwhile.

8. ROI Assessment

A credible assessment of the return on investment (ROI) for Navy S&T investments is an area of significant interest. The technology development process is fractured such that an accurate traceability of the technology investments (financial levels, funding sources, technical objectives, project durations and timeframes) is extremely difficult at best.

9. Technology Readiness Levels

This research indicates the usefulness of Technology Readiness Levels (TRLs) is less than desirable. The usefulness is greatly limited by a number of significant concerns that have to do with the quality of the technical expertise, quality, rigor, independence of the assessor. The resulting TR levels are considered to be approximations and there is some variability possible due to differences in the specific application of the technology

being assessed. Because TRLs are being viewed within DoD (and elsewhere, such as NASA) as an important metric of technical maturity and readiness these assessments warrant further study.

10. Joint Technology Transition Process

This thesis suggests the DoN FNC portfolio support programs that would provide future naval capability demonstrations to joint service commands but does not explore the details of such a process in any depth. Gaining an understanding of the various interfaces and technology transition process between the joint warfighting environment and the Naval warfighting environments would be invaluable to the development of such a change to the FNC technology transition process.

E. AFTERWORD

The Office of Naval Research (ONR) has undergone a number of significant changes over the last several years. In fact, ONR has undergone major personnel and organizational changes during the period this thesis was written and being edited. The FNC Process, in particular, has also experienced significant process changes during the period this thesis was being written and completed. I have chosen to exclude those organizational and planning process changes that were implemented beyond the period of relevance for this thesis.

The omission of recent process changes raises some concern over the possibility that the results of this thesis might be obsolete by the time it is released. The issues examined by this thesis, however, are so important, complex and difficult to address – let alone resolve – that the results of this thesis are likely to remain relevant for some time regardless of most current process changes.

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APPENDIX A: FNC SURVEY RESPONSES

Surveys were electronically mailed to personnel within the DoN community who participated in the FNC Process. This section of the appendix provides the individual survey responses from each of the four major stakeholder communities for the FNC Process; OPNAV, Science & Technology, Acquisition and the Fleet/Forces (military warfighter) communities. The responses, underlined in the text that follows, are unedited except in such cases where information provided might have identified the respondent. In those few cases the response was edited only to the extent needed to help maintain confidentiality.

The survey responses were grouped according to how the respondents categorized themselves (i.e., S&T community, Working Group support, etc). In those cases where responders provided multiple support categories a determination was made as to which stakeholder community was most appropriate for that individual (to avoid double-counting responses across different stakeholder communities). Within a stakeholder group the survey order (first, second, etc.) is random.

For this appendix the survey responses are sequentially arranged in the following order: OPNAV community responses, S&T community responses, Acquisition community responses and Warfighter (Fleet/Force) community responses. This order was taken to reflect the general transition pipeline of requirements definition, technology development, acquisition program and deployment to the user, the warfighter.

The following statement accompanied each survey sent out:

> This survey is being used as a part of a study of the DoN's technology transition processes. The Future Naval Capability (FNC) process is being used is an example of a newly established technology transition process. Completion of the survey is completely voluntary. Thank you in advance for any time and effort you can provide in support of this study.

ALL SURVEY RESPONSES WILL BE KEPT CONFIDENTIAL!

A. OPNAV COMMUNITY RESPONSES

1. Response OP-1

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? - OPNAV
- Have the goals and objectives of the FNC program been explained to your community? - Yes
- What impact has the FNC Process had within your community? – Minimal
- How does your community engage the FNC Process? - Minimally
- How important is the FNC Process to your community/operations? – Not very

Transitions

- Are you confident that programs will transition as planned? - No
- Where are the programs being transitioned to? – Those programs that already had the funds
- What metrics are being used by the IPTs? – Beats the S**t out of me
- What is the biggest obstacle to transitioning technology as planned? – Zero growth budgets
- Is there agreement on project maturity, cost and schedule? - No
- Are any of the IPT products funded from multiple IPTs? – Don’t know
- Are any of the IPT products funded jointly (other service or agency?) – Don’t know

IPT Process

- Has the IPT been effective? - No
- How are decisions made in your IPT? – The one with the most stars wins
- How frequent has the membership changed within your IPT? – Every 6 months
- How is the IPT portfolio selected? – Existing ONR projects
- Is there a process for the selection of new programs? - No
- How many data calls have you responded in over the past year (approx)? – 4

IPT Meetings

- Are you informed of IPT meetings? - No
- Have you ever attended IPT meetings? – Not since I left N7X
- How frequently does your IPT meet (approx)? - ?
- Do all community representatives attend IPT meetings? - ?
  If No, which communities regularly participate? - ?

Communication

- Are you kept informed of relevant S&T information? - Sometimes
- Where do you go to get any needed FNC information? – From Deputy PM
- Is there any info you need but do not have? – Not sure, don't know what I don't know
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) – Almost never
- What is the usefulness of the information at the S&T website? - Minimal
- How frequently do you interact with the S&T FNC representatives? – every 6 months

Satisfaction

- In general, are you satisfied with the FNC Process? - No
- What has worked? – S&T program was defended against OPNAV attack
- What has not worked? – Redirecting ONR funding toward needs
- What is the most important aspect of the FNC Process? – Cross community communication

Additional Comments

2. Response OP-2

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? Principally, the acquisition community is the immediate customer. They are the folks who must take the result of the S&T and "engineer" or design the technology into a system or component so that technology can benefit the warfighter. In that sense, the warfighter becomes the "ultimate" customer, but the acquisition community is the immediate customer.
- Have the goals and objectives of the FNC program been explained to your community? I personally think that I'm well aware of the original goals and objectives of the FNCs. However, the current FNC goals and objectives are somewhat

confusing and those goals, objectives, processes and overall FNC background are very poorly understood within my community of warfare requirements.

- What impact has the FNC Process had within your community? The impact so far is that we are expending a large amount of effort which appears to have little return on investment. We participate in a unending chain of reviews and nothing ever seems to change except for a reduction to the FNC funding and their associated program cuts. However, we've got to remember that the FNCs only started in FY-02. So it's unreasonable to judge the output of a process which has not had sufficient time to generate an output.
- How does your community engage the FNC Process? This community engages the FNCs generally through the SUBTECH process and through participation in the N706 and pillar assessments.
- How important is the FNC Process to your community/operations? The FNC Process is critical to maintaining our technological edge. Unfortunately, in its implementation, the FNCs have not focused effectively on meeting our needs. So, the FNC Process is critical but the current program being executed is not meeting our critical needs.

Transitions

- Are you confident that programs will transition as planned? No, I don't think that we predict transitions very well. However, I think that most of the work will transition … just not as planned.
- Where are the programs being transitioned to? Programs transition to 6.4 and 6.5 R&D.
- What metrics are being used by the IPTs? It varies by IPT. Some (such as TOC) do a "return on investment" analysis so their metric is dollars. Others rely on warfighter assessment of greatest need. Still other IPTs accept the ONR program manager input without much questioning.
- What is the biggest obstacle to transitioning technology as planned? Inability to maintain stability in personnel (at OPNAV principally) and budget processes that don't allow for the introduction of new things easily (sorry … that's probably two things).
- Is there agreement on project maturity, cost and schedule? No. The TRLs for transition have a fairly wide spread. Different communities have different standards that they are used to in accepting transitions.
- Are any of the IPT products funded from multiple IPTs? There are only two cases of any significance where a product relies on contributions from two FNCs. ATT has the weapon and the sensor in two different FNCs and turbine engine technology is funded in two places. However, there are a large number of dependencies in the sense that, for example, time critical strike relies on developments in KSA for there to be an overall improvement in strike capability. In fact, KSA provides the comms for many other developments to be utilized effectively.
- Are any of the IPT products funded jointly (other service or agency?) Yes, there are many areas which have jointly funded products.

IPT Process

- Has the IPT been effective? Some have; others are not (I've been on 5 IPTs). Some used to be effective but have become ineffective over time. It all seems to depend on the willingness of the Chair to spend the time to listen and exercise judgment to actively manage the program. The good IPTs have chairs that invest the effort and strive to get a balanced OPNAV input. The bad ones rubber stamp the ONR execution manager program without even bothering to synthesize the overall OPNAV input.
- How are decisions made in your IPT? Varies … consensus in some while its directed in others. The charter for IPTs specifies that they act through consensus but it would appear that most chairs don't understand that concept.
- How frequent has the membership changed within your IPT? On average, I'd say that there is a change to each IPT every six months. Certainly, it's rare today to find anyone who can remember why or how the program was initially formulated in any FNC. The most stable element (the N911 rep) has now officially disappeared so there is absolutely no corporate memory on any of the IPTs.
- How is the IPT portfolio selected? Varies.
- Is there a process for the selection of new programs? There was a process that N911 was going to implement but now that there is no N911 there isn't anyone who knows what we intended to do. But, in a nutshell, there were funds set aside beginning in FY-06 to begin new FNCs. Selection of new FNCs was scheduled to support the POM-06 process. This was also necessary to let the FNCs startup and see where the problems were before committing any additional funds. This could have been a hedge against any sever execution problems in the existing FNCs. By the way, most people would reply that there was not a process … They are wrong. There most definitely was and there was a funding set-aside. But there was absolutely no reason to advertise a process which wasn't going to be implemented until the POM-06. I'll never understand why people assume that something doesn't exist just because THEY are not made aware of it! But all of that planning is in the trash heap. Short answer is that there was a process but there doesn't seem to be one today.
- How many data calls have you responded in over the past year (approx)? 4

IPT Meetings

- Are you informed of IPT meetings? No longer sit on any IPTs.
- Have you ever attended IPT meetings? Yes; many many many!
- How frequently does your IPT meet (approx)? N/A
- Do all community representatives attend IPT meetings? NO! And they shouldn't. IPT members attend IPT meetings. If the members are doing their jobs, they are getting community input BEFORE they sit down at an IPT meeting.

  If No, which communities regularly participate? IPT members participate in IPT meetings. This has nothing to do with any community designations.

Communication

- Are you kept informed of relevant S&T information? No
- Where do you go to get any needed FNC information? ONR execution managers
- Is there any info you need but do not have? Yes
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) NEVER**.**
- What is the usefulness of the information at the S&T website? USELESS
- How frequently do you interact with the S&T FNC representatives? Monthly

Satisfaction

- In general, are you satisfied with the FNC Process? NO, but it is an improvement over the pre-FNC ways of doing business.
- What has worked? OPNAV leadership is correct but the IPTs are at too high a level to devote the time necessary. There is far more visibility into the S&T program today than there was 5 years ago.
- What has not worked? Funding of FNCs has been a dismal failure from the beginning. Too many FNCs were funded so they have inadequate resources. This was a basic failure to downselect at the start. OPNAV leadership is the right thing but it's at too high a level to spend the time required to make intelligent oversight decisions. IPTs don't hold ONR responsible for their execution. ONR spends too much on an inflated and unnecessary FNC bureaucracy. Too many people now have to do separate reviews because there is no single S&T oversight organization in OPNAV to coordinate reviews. Too many people try to apply their parochial standards to the FNCs and don't ever bother to concern themselves with the scope of the S&T that Navy has to pursue to fulfill it's widely varying missions.
- What is the most important aspect of the FNC Process? Stability and OPNAV oversight.

Additional Comments

These surveys always make me exceedingly nervous because you are bound to accept the answers of the uninformed and the ignorant along with the knowledgeable and you probably can't distinguish between them. So, a "correct" response can be buried (statistically) by a whole rash of people who have an emotional reaction based on rumor and innuendo but no real knowledge. So, I really prefer an interview format to these surveys because you can explore the basis of the subject's responses. I suspect that most of your respondents have no knowledge of the objectives and goals nor any knowledge of the initial charge by VADM Pilling to N091 to initiate the process. In fact, most folks in ONR were completely unaware of what N911 was up to with respect to FNCs for roughly the first six to eight months of effort. Only Saalfeld and Gaffney were knowledgeable of everything that was being done. This void has been filled by urban legends which are not even remotely accurate.

3. Response OP-3

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? The acquisition community. The acquisition community owns the process to deliver capability to the Fleet. The Fleet is the end user.
- Have the goals and objectives of the FNC program been explained to your community? Yes (resources). ONR has not followed through on the execution and delivery of the S&T product. Hence all of the questions by OPNAV and associated reductions.
- What impact has the FNC Process had within your community? Delayed the reduction of S&T dollars in the budget cycle. The concept of maintaining a level-funding stream to reduce the burden on managers of efforts was one of the pillars of the FNCs. Yet, ONR has routinely reduced dollars available to the FNCs to execute. Why is that – OPNAV has not reduced the dollars available to FNCs. Where are those funds being diverted and how are they being better used to support the customer?
- How does your community engage the FNC Process? Overall FNC resource sponsor
- How important is the FNC Process to your community/operations? A means to define and deliver a valued product to the customer. A "peer" product definition and review process.

Transitions

- Are you confident that programs will transition as planned? No. Unfortunately the ONR taxing schedule and fees have delayed or eliminated a significant number of the original transitions. The taxes have caused the FNCs to cancel, rescope or alter the program plans under false fiscal requirements.
- Where are the programs being transitioned to? Pet projects or politically inspired. The "ranking" process has been explained away with arm waving; not sound analysis.
- What metrics are being used by the IPTs?
- What is the biggest obstacle to transitioning technology as planned? ONR siphoning off funds to pay "taxes". The funding reductions have required the IPTs to change scope, cancel project and delayed delivery and timeframes.
- Is there agreement on project maturity, cost and schedule? Project maturity. ONR has allowed the efforts to be turned over at TRLs greater than prescribed by the BA level. This was done in most cases to persuade the acquisition community that the technology solution will meet their requirements.

- Are any of the IPT products funded from multiple IPTs? Not any more. As soon as the taxes were levied those were the first efforts to be dropped.
- Are any of the IPT products funded Jointly (other service or agency?) A couple that are politically or pet projects (IHPTET, AAAV, UCAV-N, ….).

IPT Process

- Has the IPT been effective? Yes. It has brought the 3 communities together (Acquisition, OPNAV, S&T). I did not include the "Fleet" as I believe their investment horizon is based in the acquisition community and not in the FNCs. The FNCs are a 2-10 year delivery window to the Fleet after technology transition to the acquisition community.
- How are decisions made in your IPT? Consensus. Much discussion on the ramifications of the decisions. Lately though, since Dec 02, it has been done somewhat unilaterally by ONR. The remaining IPT members have been lead along with the "short" fuse responses.
- How frequent has the membership changed within your IPT? The TOC chair, S&T Lead and Resource Sponsor has remained the same since the inception of the IPT. The acquisition rep has changed three times (averaging about 13 months). LASW has rotated quite a bit. AO has rotated quite a bit.
- How is the IPT portfolio selected?
- Is there a process for the selection of new programs? No. The cut list from the original submitted program is an excellent starting point.
- How many data calls have you responded in over the past year (approx)? None. It's been a fight to keep what was in the program in 00, 01, 02, and 03.

IPT Meetings

- Are you informed of IPT meetings? Yes
- Have you ever attended IPT meetings? Yes.
- How frequently does your IPT meet (approx)? Started out weekly, then monthly, then every two months. Now it's about 3-6 months.
- Do all community representatives attend IPT meetings? Yes. Either in person or VTC.
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? What is the definition of relevant? Many of the S&T initiatives to address the capability shortfalls were ONR efforts to begin with. I am not aware of any executed effort that was not funded by ONR in 2001. The acquisition community representatives are not involved in the issuant of BAAs or evaluating the proposals. So the short answer would be no.
- Where do you go to get any needed FNC information?
- Is there any info you need but do not have? A complete disclosure of the accounting. For an example: Why are BA01,02 & 03 funds (FNC) being used to pay for contractors, IPAs, etc in the management of the FNCs?
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/)
- What is the usefulness of the information at the S&T website? NO! The important information is/was removed by ONR comptroller (hardly an open book) since it was considered not in the best interest of ONR to have an audit trail (funds, decisions, history and free thought).
- How frequently do you interact with the S&T FNC representatives? Whenever they wanted.

Satisfaction

- In general, are you satisfied with the FNC Process? The vision has been tainted and it's back to business as usual.
- What has worked? The establishment of the communication channels amongst the communities. The strength of the Acquisition & Resources communities to remain engaged throughout the process despite the fictitious fiscal environment they have been exposed to.
- What has not worked? Having one and two star admirals justify their decisions (IPT programs) to 0-6s; Any and all taxes levied. These were allocated in the plan; Navy dollars funding USMC programs at expense of Navy programs; FNC funding accounted for less than 30% of Navy S&T account (BA 01/02/03). So what is the other 70% being spent on?; Stovepiping of product lines within the IPT selection process; Inability of the principals to look outside of their respective domains (ships to consider aviation; tactical versus logistics; and so on)

Additional Comments

ONR Management Costs: ONR receives roughly $50M per year outside of the S&T budget to pay for the management of assigned S&T programs; including personnel salaries. The establishment of the FNCs did not result in any change to the total amount of funds that ONR presently manages. The FNCs efforts presently account for less than 30% of the entire N091 funds managed by ONR. There was a significant reduction in terms of the number of individual efforts performed with the FNC allocated dollars. It is therefore reasonable to expect that ONR could manage the FNC allocated funds with roughly the same number of personnel; which was possible prior to the FNC establishment. Nevertheless, they have seen fit to increase staffing by setting up a fairly robust additional management structure for the FNCs. Rather than reassigning current ONR personnel to fill these positions, they have elected to bring in a substantial number of IPAs, contractors and detailees. These people are then charges to the dollars allocated for the various FNC projects for which they are to manage. A quick perusal of the ONR phonebook indicates a large number of personnel in the organization who are listed as detailees, NRL employees or IPAs; all of whom are funded from S&T funds regardless of their function within t he organization.

In an environment where S&T dollars and their associated buying power has been on the decline, ONR is exacerbating the problem by diverting S&T execution funds to an increasing amount S&T management funds. This management initiative results in fewer research dollars leaving Ballston Tower. Further, it is almost impossible to track the amount of dollars involved since the detailee and IPA funds can look just like project funds sent to a Warfare Center or UARC. This is a significant drawdown of critical funding which the resource sponsor expected to be available for the actual conduct of S&T efforts versus salaries. Only now are the FNC IPTs beginning to ascertain the reduction in FNC transitions that can be supported due to this whittling away of the dollars. When coupled with the expenses for the new unfounded FNCs and the “other” withholds, there is a significant reduction in FNC productivity and capabilities lost.

4. Response OP-4

About You

- What community do you represent?
  S&T / Requirements / Acquisition / <u>Resources</u> / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  <u>Principal IPT</u> / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? <u>Warfighter</u>
- Have the goals and objectives of the FNC program been explained to your community? <u>Yes</u>
- What impact has the FNC Process had within your community?
- How does your community engage the FNC Process?
- How important is the FNC Process to your community/operations?

Transitions

- Are you confident that programs will transition as planned? <u>No</u>
- Where are the programs being transitioned to?
- What metrics are being used by the IPTs?
- What is the biggest obstacle to transitioning technology as planned? <u>Industry NIH, schedule slips & better tech alternatives.</u>
- Is there agreement on project maturity, cost and schedule?
- Are any of the IPT products funded from multiple IPTs? <u>Not in TCS</u>
- Are any of the IPT products funded Jointly (other service or agency)? <u>Not in TCS</u>

IPT Process

- Has the IPT been effective? <u>Good dialog but execution objective still weak.</u>
- How are decisions made in your IPT? <u>Collectively</u>?
- How frequent has the membership changed within your IPT? <u>Quarterly</u>
- How is the IPT portfolio selected?
- Is there a process for the selection of new programs? <u>Not during my stay.</u>
- How many data calls have you responded in over the past year (approx)?

IPT Meetings

- Are you informed of IPT meetings? <u>yes</u>
- Have you ever attended IPT meetings? <u>yes</u>
- How frequently does your IPT meet (approx)? <u>every 6 weeks</u>
- Do all community representatives attend IPT meetings? <u>yes</u>
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? yes
- Where do you go to get any needed FNC information? To IPT reps
- Is there any info you need but do not have? A true prioritization of requirements.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) monthly
- What is the usefulness of the information at the S&T website? wrt FNC – not updated.
- How frequently do you interact with the S&T FNC representatives? weekly

Satisfaction

- In general, are you satisfied with the FNC Process? Initially – sort of, later – no.
- What has worked? Getting the stakeholders together.
- What has not worked? ONR appears to do what it wants.
- What is the most important aspect of the FNC Process?
  Getting visibility into ONR decision-making/results.

Additional Comments

Answers reflect July 99 to July 00 timeframe. Respondent not actually involved in FNC's since then.

There still remains an element of "game playing" which appears to be motivated to secure the most $$ vs. what's right for the fleet.

Over-emphasis on transition – transition argument is disingenuous. Needs to be revisited & redefined. Evidence of S&T product in Acq community POM submittal unrealistic. Few current important capabilities were 1st driven by a requirement.

Last thought on transition – it has been said that there is insufficient resources in Navy Acquisition TOA to truly transition the number of products pursued by the FNC program.

If ONR wants to transition it should look at its current set of 6.3 products and begin packaging these to solve acquisition community needs.

5. Response OP-5

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
  Exposure and participation in the FNC Process was related to a 2 year assignment (2000 to 2002) as a Technology Advisor to an OPNAV Warfare Directorate.

- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other
  Actively engaged with the Time Critical Strike FNC, with some collateral support to the Knowledge Superiority & Assurance, Autonomous Operations, and Littoral Combat & Power Projection FNC's.

FNC General

- Who is the "customer" for the FNC Process? The operational forces are the ultimate customer and there was reasonable effort by the FNC managers to "connect" with the operational forces. However, the response and participation back from that customer community did not meet the needs of the FNC programs. OPNAV (N7 Requirements) were expected to plan and facilitate the transition of FNC products for the operational forces.
- Have the goals and objectives of the FNC program been explained to your community? The FNC managers made a reasonable effort to educate the OPNAV staffs and operational force representative on the FNC program. Site visits and program planning review opportunities were planned and coordinated.
- What impact has the FNC Process had within your community? Limited. FNC transition planning should have been a primary item of interest and would require action officers to develop detail for the outyears in the FYDP. OPNAV Staff were primarily interested in the current budget year and the next POM/PR cycle (2 yrs). Getting OPNAV requirement officers to look beyond this period is very difficult and outyear plans could be classified as placeholders with limited detail. A number of factors contributed to this – The constant budget churn "why bother with detailed long range plans when the current plan changes weekly", requirement officer (aka action officers) training where most of them rotate in from a fleet assignment and get little or no training on the PPBS process, and the constant rotation of officers where they arrive with 3 yr orders but typically get slated for the next assignment and are either physically transferred or are engaged in the training pipeline for their next assignment within 18mos.
- How does your community engage the FNC Process? From my experience, the requirement officers did not engage the FNC Process unless they were prompted by leadership. Engagement is defined as "Attend the meeting, File the brief, and resume normal activity". Follow on activity was very limited until prompted by leadership to attend the next meeting/brief or to provide an update on activity.

- How important is the FNC Process to your community/operations? Very important, however, based on the level of transition requirement planning activity the FNC Process was not taken very seriously.

Transitions

- Are you confident that programs will transition as planned? No.
- Where are the programs being transitioned to? Limited attempts to fit them into the outyear budget plan for existing product lines. Significant resistance in establishing new program element lines within the budget to service the needs related to FNC product transition.
- What metrics are being used by the IPTs? Direct language for FNC product transition in the R2 budget displays was the primary desired metric.
- What is the biggest obstacle to transitioning technology as planned? See discussion on outyear planning and requirement officer training & rotation. In addition, there was competition between product improvement plans for existing system being promoted by the acquisition community (PEO's and Defense Contractors) and the transition of FNC products. Risk avoidance and requirement officer reliance on the PEO's to provide the detail to respond to budget drills typically resulted in the FNC transition being pushed aside.
- Is there agreement on project maturity, cost and schedule? Yes, in the form of MOU's, transition sponsorship letters, etc. However, most of the agreements contained language that served as an escape clause should a later decision be made not to support the transition.
- Are any of the IPT products funded from multiple IPTs? Yes.
- Are any of the IPT products funded Jointly (other service or agency)? Do not recall.

IPT Process

- Has the IPT been effective? To some degree. The IPTs provided the forum to sort out the detail on enabling capabilities which gave some guidance to the technical community on what needed to be developed and demonstrated. The IPT did little to engage the budget and program plans required to ensure transition of successful technology products.
- How are decisions made in your IPT? Meetings coordinated by ONR IPT reps, where if the organization (N76, N77, N78, etc) the had primary responsibility over a specific task within the FNC was present then a productive session was held. Quite often the actual member of the IPT was not available do to calendar conflicts and either did not show or a representative was sent without decision authority. This required ONR reps to follow up and work the issue one-on-one outside the IPT.
- How frequent has the membership changed within your IPT? Some members were in place for extended periods (ONR and Acquisition Reps), while others turned over often (CFFC, OPNAV, MCCDC).
- How is the IPT portfolio selected? Not sure what this means.

- Is there a process for the selection of new programs? There was an extensive process that established the initial FNC programs and the elements within. However, the result could be viewed as a reshuffle of the existing 6.2 & 6.3 programs and the addition of a few new submissions.
- How many data calls have you responded in over the past year (approx)? None

IPT Meetings

- Are you informed of IPT meetings? Email & Phone Call.
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? 2 or 3 times per year.
- Do all community representatives attend IPT meetings? No
- If No, which communities regularly participate? See note on IPT Decision question.

Communication

- Are you kept informed of relevant S&T information? In general yes, depended on the ONR program manager methods and communication skill. Some did very well, others did not.
- Where do you go to get any needed FNC information? To the specific program manager that is responsible. Some kept websites up with key information while others had no website or let the info on the website lapse.
- Is there any info you need but do not have? If you knew the FNC organizational structure and proper POC information, you could always get the needed info.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) See note on Where do you go to get FNC Info.
- What is the usefulness of the information at the S&T website? See note on Where do you go to get FNC Info. For those sites that were kept up with current info it was an excellent method and source for information.
- How frequently do you interact with the S&T FNC representatives? At the time, I made contact on a weekly basis.

Satisfaction

- In general, are you satisfied with the FNC Process? I felt that the process was a significant improvement over the previous methods used to execute 6.2 and 6.3 programs.
- What has worked? The implementation of the process in general. Provides the opportunity to the various communities to participate in the identification and review process of establishing FNC projects, to track project performance, and to plan for transition. Improved the alignment of ONR programs.
- What has not worked? The active and meaningful participation from the OPNAV requirements community and operational force representatives. The opportunity was presented, however I do not feel that they engaged at the level required.

- What is the most important aspect of the FNC Process? Aligned the 6.2 & 6.3 efforts with warfighter capability needs and attempted to place emphasis on transition of products and technology.

Additional Comments

Please note that these are personal observations based upon my awareness of activities around me.

The lack of well defined roadmaps that provide a detailed plan from Discovery to De-Mil (birth to death) hinders the FNC Process. Resources were not being applied to develop the level of detail required to perform proper analysis and complete trade off studies need for a defendable investment plan. Many of the individuals assigned to these tasks work them as collateral duty assignments where the needs of their primary assignments quite often push the off on the back burner where they are only addressed when an "interrupt" goes off. In this mode the "path of least resistance" with the lowest risk is applied as the primary decision tool. Result – roadmaps full of holes and limited transition activity. Hopefully, the Mission Capability Package approach that was standing up as I was finishing my tour has evolved and might provide a fix.

B. S&T COMMUNITY RESPONSES

1. Response ST-1

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? Excellent question. From the Lab perspective, the "customer," unmistakably, is ONR.
- Have the goals and objectives of the FNC program been explained to your community? I think there has been some attempt at explanation, but the "goals and objectives" often seem to be overshadowed by the process (which, again from a Navy Lab perspective, seems to have been organized to benefit certain key favored industries, consulting firms, or business organizations).
- What impact has the FNC Process had within your community? Quite a dampening effect. In theory, the FNC Process should "focus" efforts on identified requirements; in practice, the focus of resources (i.e., money) on key favored industrial partners seems to have frozen or eliminated a significant portion of Navy Lab S&T work.
- How does your community engage the FNC Process? My community responded to the FNC Call for Proposals, but despite high-level, organized engagement, was not particularly successful at cornering a significant share of the work. This has resulted in the perspective alluded to, two questions above.
- How important is the FNC Process to your community/operations? Insofar as a large fraction of S&T funding now seems tied to the FNCs, I guess the answer has to be that it is very important. No doubt, many in the S&T community right now would like to see a reduction of emphasis on the FNCs and a broadening of opportunities.

Transitions

- Are you confident that programs will transition as planned? I could only speculate on this. I have no doubt that the PIs of the respective projects are confident, as they should be – but as to whether the programs will, realistically speaking, transfer on-time, within budget, etc., I really cannot say.
- Where are the programs being transitioned to? In theory, the programs should be transitioned to the Fleet/Force. In practice, I have not seen an adequate explanation off the planned transitions.
- What metrics are being used by the IPTs? Have not seen any published metrics.
- What is the biggest obstacle to transitioning technology as planned? Are you referring to the FNCs, or technology transition in general? If the latter, I would guess

the biggest obstacle is that, by the time the technology is ready to transfer, it is already seriously out of date. At the same time, as delivered, it is often poorly designed and executed (from a Human Factors perspective).

- Is there agreement on project maturity, cost and schedule? (This question, and many that follow, are not relevant to me)
- Are any of the IPT products funded from multiple IPTs?
- Are any of the IPT products funded Jointly (other service or agency)?

IPT Process

- Has the IPT been effective?
- How are decisions made in your IPT?
- How frequent has the membership changed within your IPT?
- How is the IPT portfolio selected?
- Is there a process for the selection of new programs?
- How many data calls have you responded in over the past year (approx)?

IPT Meetings

- Are you informed of IPT meetings? Generally, no.
- Have you ever attended IPT meetings? Yes – but infrequently.
- How frequently does your IPT meet (approx)?
- Do all community representatives attend IPT meetings?
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? This is a significant challenge in the S&T area. My lab is continually working to identify means of improving information flow. We are not, in my opinion, at a point where we can rest comfortably and say that we have achieved optimal communication.
- Where do you go to get any needed FNC information? Often, directly (personally) from ONR.
- Is there any info you need but do not have? Interesting question. Here's another, in like vein: What do you need to know that you do not currently know that you need to know?
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Occasionally.
- What is the usefulness of the information at the S&T website? Moderate to good.
- How frequently do you interact with the S&T FNC representatives? Occasionally.

Satisfaction

- In general, are you satisfied with the FNC Process? As indicated above, from my perspective within the Navy Lab system, the FNC system has not been an unalloyed

success. Personally speaking, I can certainly understand and applaud the goals of the FNC Process – to focus resources on identified requirements. From a practical perspective, I am less than confident that it is working as well as it should.

- What has worked? The concept is a good one.
- What has not worked? The people I know in the labs are not sanguine that the process has been clearly articulated or properly executed. Furthermore, a non-trivial portion of the labs' work has been shut out due to lack of funding. Although I cannot speak for everyone, the entire FNC Process seemed to materialize virtually overnight and to starve many competing programs. This perception is, no doubt, at least in part a byproduct of a less-than-successful program of communication.
- What is the most important aspect of the FNC Process? The notion that the Navy is willing to focus its resources on its most important Fleet/Force requirements. At the same time, it is essential that all stakeholders in the Naval Research Enterprise clearly understand the importance of this undertaking and are onboard with the process as well.

Additional Comments

2. Response ST-2

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? My experience is limited, but I feel that the purpose of the FNCs is to demonstrate the maturity (and mature if necessary) of a particular technology or set of technologies to support their introduction into a SDD program either in total or in part. As such, the customer would be a PMA or PMS ultimately.
- Have the goals and objectives of the FNC program been explained to your community? Yes.
- What impact has the FNC Process had within your community? I think that the process has had little impact as yet. The primary reason for this comment is that it is too early in the FNC's life to determine if it will successfully transition technology to programs. I'm also concerned that there lacks continuity between the 6.1 and 6.2 world such that new concepts would flow from research up.
- How does your community engage the FNC Process? We are currently helping to execute several projects.
- How important is the FNC Process to your community/operations? If their promise is kept, they could be an extremely important source of technology to feed new concept improvement and development.

Transitions

- Are you confident that programs will transition as planned? No. Almost the opposite although I'm doubtful that there is much the FNC Process can do about this. However, I'm am equally as confident that there exists opportunities for the technology demonstrated to find transitions outside of their plan. If the only metric used is the metric of meeting the planned transition, then there is a significant risk that the majority of the FNC's contributions to systems will not be accounted for when measuring their value.
- Where are the programs being transitioned to? I've yet to see one of the projects sponsored by an FNC transition directly to another project or program. I have a very limited perspective and experience base, so the above is not meant to be a strong statement.
- What metrics are being used by the IPTs? It appears to me that the only metric being used to date is the metric of direct transition as documented in the program execution plan.

- What is the biggest obstacle to transitioning technology as planned? The system is not put together to easily accept technology generically demonstrated under the FNC program. Frankly, I feel that the system dis-incentivizes the transition. To try and quickly summarize, it is my opinion that the contractors working military systems are incentivized to fail as they continue to be paid for failure while success completes a program. As such, new technology that will improve things not specifically developed by the contractor is not easily inserted into a program being executed by a contractor. There are examples of this. If you wanted to significantly increase the percentage of transitions from the FNC to a program, choose only projects that are executed by contractors and that are a significant enhancement to an existing system such that they have it locked up and there is a large tail to bring it to fruition. This way they are incentivized to transition.
- Is there agreement on project maturity, cost and schedule? Yes and ideally it is documented in the program execution plan.
- Are any of the IPT products funded from multiple IPTs? I don't know.
- Are any of the IPT products funded Jointly (other service or agency)? I don't know.

IPT Process

- Has the IPT been effective? My limited experience with the IPTs indicate that they are adding a measure of what they were intended to although I'm not a big fan of the IPT process.
- How are decisions made in your IPT? I'm not really in the know on this.
- How frequent has the membership changed within your IPT? Again, I really don't know.
- How is the IPT portfolio selected? I've seen several different ways this has happened. Ideally, there is a call for proposals with direction as to what is being looked for. Those proposals are evaluated and voted on by the IPT. I've seen this work fairly well, but I've also seen this process done in appearance only (in my opinion).
- Is there a process for the selection of new programs? Not an official one that I am aware of. I think this is a really large problem with the FNCs as they have been locked up since the first programs were selected and thus do not have a viable way of introducing new concepts as need and execution changes.
- How many data calls have you responded in over the past year (approx)? A couple.

IPT Meetings

- Are you informed of IPT meetings? No.
- Have you ever attended IPT meetings? No…I don't think I'm invited.
- How frequently does your IPT meet (approx)? I'm not a part of an IPT.
- Do all community representatives attend IPT meetings? Dunno.
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? N/A
- Where do you go to get any needed FNC information?
  I call the program manager or one of his/ her designees.
- Is there any info you need but do not have? Yes.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Not often, but I have used it. Information seems old.
- What is the usefulness of the information at the S&T website? Too generic and old.
- How frequently do you interact with the S&T FNC representatives? Often.

Satisfaction

- In general, are you satisfied with the FNC Process? No. Without a viable way to insert new concepts, the process seems broken. Also, the level of taxation is too high.
- What has worked? Too early to tell.
- What has not worked? Too early to tell, but certainly the introduction of new programs is necessary if the FNC Process is to remain viable.
- What is the most important aspect of the FNC Process? Demonstration and maturation of technologies ready to insert into programs at the SDD level.

Additional Comments

3. Response ST-3

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? PEOS/SYSCOMS
- Have the goals and objectives of the FNC program been explained to your community? Explained from an ONR viewpoint.
- What impact has the FNC Process had within your community? Some positive as far as PORs go. Not much in where we go beyond PORs.
- How does your community engage the FNC Process? Yes, via TTAs.
- How important is the FNC Process to your community/operations? Probably not very much.

Transitions

- Are you confident that programs will transition as planned? Partially. Budget/Schedule fluctuations impact the best intentions.
- Where are the programs being transitioned to? PORs
- What metrics are being used by the IPTs? Real "Metric" seems to be: does it have a TTA?
- What is the biggest obstacle to transitioning technology as planned? Acquisition Managers lack of real interest.
- Is there agreement on project maturity, cost and schedule? Yes.
- Are any of the IPT products funded from multiple IPTs? I know of one: REDS.
- Are any of the IPT products funded Jointly (other service or agency?) None known.

IPT Process

- Has the IPT been effective? No, too many changes in "Leadership".
- How are decisions made in your IPT? OPNAV member decides with rest of IPT concurring.
- How frequent has the membership changed within your IPT? Far too often.
- How is the IPT portfolio selected? S&T member brings in recommended list, IPT concurs.
- Is there a process for the selection of new programs? Yes, working level IPT ranks proposed new starts.
- How many data calls have you responded in over the past year (approx)? 2-3.

IPT Meetings

- Are you informed of IPT meetings? Yes
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? Several times per year.
- Do all community representatives attend IPT meetings? Yes, in person or by VTC. If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? Not completely. Have to find some of this myself.
- Where do you go to get any needed FNC information? Multiple sources.
- Is there any info you need but do not have? Not sure.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Rarely.
- What is the usefulness of the information at the S&T website? Marginal.
- How frequently do you interact with the S&T FNC representatives? Almost daily.

Satisfaction

- In general, are you satisfied with the FNC Process? No.
- What has worked? Better linkage between S&T and Acquisition.
- What has not worked? Recognition of the interdependencies between FNCs and between multiple FNCs and PORs and how to address these.
- What is the most important aspect of the FNC Process? Involvement of ONR in Acquisition process.

Additional Comments

FNCs are, in effect, 12 new stovepipes.
No real system view, emphasis is just on FNC EC to one aspect of a single POR.
No planning beyond PORs and what FNC should look like for this.
FNCs are not in step with Sea Power 21.
FNCs don't really look at joint world.
No ONR IPT above the IPTs at the 12 FNC level.
Lack of real OPNAV/SYSCOM/PEO interest in the FNC program.

4. Response ST-4

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? Multiple: Requirements / Acquisition / Resources / Fleet
- Have the goals and objectives of the FNC program been explained to your community? Yes
- What impact has the FNC Process had within your community?
- How does your community engage the FNC Process?
- How important is the FNC Process to your community/operations?

Transitions

- Are you confident that programs will transition as planned? Not confident wrt transitions
- Where are the programs being transitioned to? Multiple SYSCOM programs
- What metrics are being used by the IPTs? Do not know
- What is the biggest obstacle to transitioning technology as planned? The transitioning technology competes with or threatens an on-going activity that has an entrenched constituency
- Is there agreement on project maturity, cost and schedule?
- Are any of the IPT products funded from multiple IPTs?
- Are any of the IPT products funded Jointly (other service or agency)?

IPT Process

- Has the IPT been effective?
- How are decisions made in your IPT?
- How frequent has the membership changed within your IPT?
- How is the IPT portfolio selected?
- Is there a process for the selection of new programs?
- How many data calls have you responded in over the past year (approx)?

IPT Meetings

- Are you informed of IPT meetings?
- Have you ever attended IPT meetings?
- How frequently does your IPT meet (approx)?

- Do all community representatives attend IPT meetings?
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information?
- Where do you go to get any needed FNC information?
- Is there any info you need but do not have?
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/)
- What is the usefulness of the information at the S&T website?
- How frequently do you interact with the S&T FNC representatives?

Satisfaction

- In general, are you satisfied with the FNC Process?
- What has worked?
- What has not worked?
- What is the most important aspect of the FNC Process?

Additional Comments

Have any of the FNC's been judged to have failed and been terminated or had their "Board of Directors" replaced?

5. Response ST-5

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other--None

FNC General

- Who is the "customer" for the FNC Process? Primary customer is the PMO to which technology will transition
- Have the goals and objectives of the FNC program been explained to your community? Yes
- What impact has the FNC Process had within your community? S&T proposals to ONR now focus on identified FNC thrust areas; e.g., AO.
- How does your community engage the FNC Process? As an outsider, my sense is that NAVAIR's S&T community, as a whole, does not seem to constructively engage with ONR in the FNC Process. Engagement seems limited to those specific NAVAIR S&T practitioners who are funded by an FNC.
- How important is the FNC Process to your community/operations? FNCs fund a portion of NAVAIR's S&T base (I have no figures). The FNC Process itself forces some dialogue between NAVAIR's S&T practitioners and the PMAs, ostensibly facilitating transition.

Transitions

- Are you confident that programs will transition as planned? Discussions with some PMAs and S&T practitioners suggest that the general sense is that transition rates won't be noticeably better than before the FNC Process.
- Where are the programs being transitioned to? Don't know
- What metrics are being used by the IPTs? Don't know
- What is the biggest obstacle to transitioning technology as planned? Two obstacles are (1) the difficulty in constructing a technology transition roadmap (i.e., identifying technology insertion opportunities for a platform or system), and (2) NIH; i.e., the difficulty in getting a contractor to transition a 'Navy' solution once matured.
- Is there agreement on project maturity, cost and schedule? Don't know
- Are any of the IPT products funded from multiple IPTs? Don't know
- Are any of the IPT products funded Jointly (other service or agency)? Don't know

IPT Process

- Has the IPT been effective? N/A
- How are decisions made in your IPT? N/A
- How frequent has the membership changed within your IPT? N/A

- How is the IPT portfolio selected? N/A
- Is there a process for the selection of new programs? N/A
- How many data calls have you responded in over the past year (approx)? N/A

IPT Meetings

- Are you informed of IPT meetings? N/A
- Have you ever attended IPT meetings? N/A
- How frequently does your IPT meet (approx)? N/A
- Do all community representatives attend IPT meetings? N/A
- If No, which communities regularly participate? N/A

Communication

- Are you kept informed of relevant S&T information? Yes
- Where do you go to get any needed FNC information? Website or ONR.
- Is there any info you need but do not have? No
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) 2 -3 times a year
- What is the usefulness of the information at the S&T website? Very limited; top-level info.
- How frequently do you interact with the S&T FNC representatives? N/A

Satisfaction

- In general, are you satisfied with the FNC Process? Can't comment.
- What has worked? Can't comment.
- What has not worked? Can't comment.
- What is the most important aspect of the FNC Process? Can't comment.

Additional Comments

6. Response ST-6

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? OPNAV, BUPERS, NETC, Fleet Training, SYSCOM PMA/PMS Offices
- Have the goals and objectives of the FNC program been explained to your community? Yes
- What impact has the FNC Process had within your community? MPT Stakeholders are closer
- How does your community engage the FNC Process? EIPT
- How important is the FNC Process to your community/operations? FNC, not very. EIPT, very.

Transitions

- Are you confident that programs will transition as planned? Mostly
- Where are the programs being transitioned to? BUPERS, NETC, OSD ADL-CO-LAB, L-M, ARC-I, SMMTT
- What metrics are being used by the IPTs? Focus has continually been on how to take cuts to the program.
- What is the biggest obstacle to transitioning technology as planned? Stable S&T funding.
- Is there agreement on project maturity, cost and schedule? Yes, via TTAs.
- Are any of the IPT products funded from multiple IPTs? Yes, also by KSA.
- Are any of the IPT products funded Jointly (other service or agency)? Yes, OSD has also invested.

IPT Process

- Has the IPT been effective? Yes.
- How are decisions made in your IPT? Voting of primary members.
- How frequent has the membership changed within your IPT? As military officers roll.
- How is the IPT portfolio selected? Via working groups.
- Is there a process for the selection of new programs? Yes – sort of.
- How many data calls have you responded in over the past year (approx)? 37. Easily more than one per week.

IPT Meetings

- Are you informed of IPT meetings? Yes.
- Have you ever attended IPT meetings? Yes.
- How frequently does your IPT meet (approx)? 6 months and e-mails constantly.
- Do all community representatives attend IPT meetings? Yes.
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? Yes.
- Where do you go to get any needed FNC information? ONR FNC support staff.
- Is there any info you need but do not have? Yes, FY05 – FY09 ONR TOA $$
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Never
- What is the usefulness of the information at the S&T website? ??
- How frequently do you interact with the S&T FNC representatives? Monthly.

Satisfaction

- In general, are you satisfied with the FNC Process? Yes.
- What has worked? No.
- What has not worked? Rules keep changing, ONR does not really support all FNCs.
- What is the most important aspect of the FNC Process? The formation of the EIPT.

Additional Comments

- If you read the FNC documentation, the process is a good one. In reality, though, ONR, N-091, TOG, etc., etc., keep pulling up the tree to check the roots.
- ONR leadership has failed the FNC Process. Witness the turnover in S&T leads. Instead of being held in high esteem by ONR, FNCs appear to be an obstacle to CNR's plans.
- Funding instability AND requirements for signed TTAs has left a bad taste in the mouths of our customers. We've had to reneg on TTAs we've signed.
- Stabilize the funding & stop reviewing us all the time. Give us time to do some of the work!

7. Response ST-7

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? Warfighter
- Have the goals and objectives of the FNC program been explained to your community? YES
- What impact has the FNC Process had within your community? Funding for tech transition
- How does your community engage the FNC Process? Via ONR FNC managers
- How important is the FNC Process to your community/operations? Highly important to continue Technology advancement/demonstration

Transitions

- Are you confident that programs will transition as planned? No
- Where are the programs being transitioned to? Weapon Programs
- What metrics are being used by the IPTs? Transition Planning
- What is the biggest obstacle to transitioning technology as planned? NAVAIR
- Is there agreement on project maturity, cost and schedule? No
- Are any of the IPT products funded from multiple IPTs? Unknown
- Are any of the IPT products funded Jointly (other service or agency?) No

IPT Process

- Has the IPT been effective? Unknown
- How are decisions made in your IPT?
- How frequent has the membership changed within your IPT?
- How is the IPT portfolio selected?
- Is there a process for the selection of new programs? No
- How many data calls have you responded in over the past year (approx)? 2

IPT Meetings

- Are you informed of IPT meetings? No
- Have you ever attended IPT meetings? No
- How frequently does your IPT meet (approx)?
- Do all community representatives attend IPT meetings?
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? Yes
- Where do you go to get any needed FNC information? FNC ONR manager
- Is there any info you need but do not have? No
- How frequent do you use the DoN S&T website? Never
- What is the usefulness of the information at the S&T website?
- How frequently do you interact with the S&T FNC representatives?

Satisfaction

- In general, are you satisfied with the FNC Process? No
- What has worked? Yes, technology demos are still funded
- What has not worked? Program Dynamics
- What is the most important aspect of the FNC Process? Communication S&T/acquisition

Additional Comments

C. ACQUISITION COMMUNITY RESPONSES

1. Response ACQ-1

About You

- What community do you represent?
  S&T / Requirements / <u>Acquisition</u> / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / <u>Other</u>

FNC General

- Who is the "customer" for the FNC Process? <u>The eventual user of the technology is the Sailor and Marine. However, the most immediate customers are the PARMs [sic] and the Major Acquisition Program Managers.</u>
- Have the goals and objectives of the FNC program been explained to your community? <u>Yes, but the explanation has not been consistent either over time or by presenter.</u>
- What impact has the FNC Process had within your community? <u>Little to no impact</u>.
- How does your community engage the FNC Process? <u>There are acquisition representatives as members of some of the FNCs and periodically Major Acquisition Program team members meet with FNC membership.</u>
- How important is the FNC Process to your community/operations? <u>On a day to day basis not very important. However, on a long term basis it is one of the few places where new technology is being developed to an acceptable level of risk for insertion into acquisition programs.</u>

Transitions

- Are you confident that programs will transition as planned? <u>NO !</u>
- Where are the programs being transitioned to? <u>Many of the FNC programs are being transitioned to major ship programs.</u>
- What metrics are being used by the IPTs?
- What is the biggest obstacle to transitioning technology as planned? <u>The state of the technology is not at the maturity level desired to sufficiently reduce risk and the DoD budgeting process does not allow major programs to budget for emergent technology insertion into programs. Additionally prime systems integrators have little incentive to use new technology that does not increase their profits.</u>
- Is there agreement on project maturity, cost and schedule? <u>Sometimes but frequently not.</u>
- Are any of the IPT products funded from multiple IPTs? <u>YES</u>
- Are any of the IPT products funded Jointly (other service or agency)? <u>Not that I'm aware of.</u>

IPT Process

- Has the IPT been effective? N/A
- How are decisions made in your IPT? N/A
- How frequent has the membership changed within your IPT? N/A
- How is the IPT portfolio selected? N/A
- Is there a process for the selection of new programs? N/A
- How many data calls have you responded in over the past year (approx)? N/A

IPT Meetings

- Are you informed of IPT meetings? Seldom
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? N/A
- Do all community representatives attend IPT meetings? N/A
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? New information is not pushed out very aggressively.
- Where do you go to get any needed FNC information? FNC websites.
- Is there any info you need but do not have?
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) At least once a week.
- What is the usefulness of the information at the S&T website? The latency of the information does not make it very useful.
- How frequently do you interact with the S&T FNC representatives?

Satisfaction

- In general, are you satisfied with the FNC Process? NO
- What has worked? It has focused the Navy's applied research managed by ONR to some extent.
- What has not worked? Funding has not been stable nor of the amount originally planned when the FNC Process was started.
- What is the most important aspect of the FNC Process? Having points of contact for certain technologies that have potential to transition.

Additional Comments

Technology transition is not an easy business and frankly does not appeal to the personality of many outstanding research scientists. I believe it would enhance each of the FNCs if they had a transition advocate to help facilitate the "marketing" and identification of potential applications for the various technologies in development by the FNCs.

2. Response ACQ-2

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC? Across most all FNCs
  Principal IPT / Working Group / Project Level / Other

FNC General

- Who is the "customer" for the FNC Process? Customers for FNC products are the PMs (in support of the warfighters)
- Have the goals and objectives of the FNC program been explained to your community? Early on (98) the theory was described. Questions such as "how do new projects begin?" were deferred
- What impact has the FNC Process had within your community? Some initial modest improvement in OPNAV participation (in FNC Chair role). Some increased communication between PMAs and ONR FNC PMs. In both cases, improvement has seemed to fade as people have turned over
- How does your community engage the FNC Process? Engagement from competency technologists is mostly a "self help" approach. Processes such as the ATRB attempts to match up future PMA needs and technology solutions and make this known to the FNCs.
- How important is the FNC Process to your community/operations? Importance lies in the flow of money to conduct S&T. For whatever reason, S&T funds are in decline and no where more than at the warfare centers. FNC managers seem to be directing funding away from NAWC.

Transitions

- Are you confident that programs will transition as planned? In the case of signed TTAs, confidence is higher. Lack of regular and ongoing comm[unication]s puts even these agreements at risk.
- Where are the programs being transitioned to? PMAs
- What metrics are being used by the IPTs? This has never been well explained (or consistent across all FNCs). TTAs should not be the only measure.
- What is the biggest obstacle to transitioning technology as planned? As before, lack of comms with transition sponsor
- Is there agreement on project maturity, cost and schedule? My view is that some of this exists but on a case by case basis
- Are any of the IPT products funded from multiple IPTs? There seemed to be some initial cases of this but the recurring budget cuts seems to have forced them into one FNC or another
- Are any of the IPT products funded Jointly (other service or agency?) Do not know

IPT Process

- Has the IPT been effective? Short answer is NOT VERY. But must be considered against what the alternative would have been. Pre-FNC approach would have suffered even more from the continuing reduction of budgets.
- How are decisions made in your IPT? My perspective is that each FNC is different.
- How frequent has the membership changed within your IPT? My observation is all too often
- How is the IPT portfolio selected? From the outside, each FNC has a different, subjective method
- Is there a process for the selection of new programs? If there is, I have not heard of it other than the prospect of replacing a terminated project—which possibility seems to have been overtaken by budget cuts before a new project could be started.
- How many data calls have you responded in over the past year (approx)? N/A

IPT Meetings

- Are you informed of IPT meetings? Not formally—word of mouth at best.
- Have you ever attended IPT meetings? Yes, occasionally.
- How frequently does your IPT meet (approx)? N/A
- Do all community representatives attend IPT meetings? Not the ones I attended.
  If No, which communities regularly participate? Lots of support contractors and other than "air."

Communication

- Are you kept informed of relevant S&T information? No
- Where do you go to get any needed FNC information? My own POC network within the FNCs
- Is there any info you need but do not have? Latest FNC memberships, recent briefs, current POR
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Never, anymore. After numerous initial attempts, found there was almost no info posted
- What is the usefulness of the information at the S&T website? Somewhat useful at the beginning, but that info has never been updated
- How frequently do you interact with the S&T FNC representatives? NTTO occasionally, Acquisition Chair—never, ONR PMs every few months

Satisfaction

- In general, are you satisfied with the FNC Process? No.
- What has worked? Consolidation of focus areas to allow meaningful accomplishments
- What has not worked? Fencing the FNC accounts from cuts (even discretionary ones)
- What is the most important aspect of the FNC Process? A formal process to examine and plan for future technology needs. Without this, S&T investment would be chaos.

Additional Comments

Recent DoN directives seem to promote "industry" models for conducting our business. Do not fully agree as motives are different, but even if we must, DoN fails to stick to the model of industry that places significant and faithful investment in R&D (~2% off the top line) and does not allow that level to be cut. S&T cannot be allowed to be an afterthought. While we complain about a lack of money for current military budgets (and "war" bills), S&T is not successful when viewed as a totally COTS approach. Technology must be worked sufficiently ahead of the insertion point to allow for successfully and affordably integrating the solution into the targeted "system"—both the platform and its network-centric operational scenario. Remember successful S&T means "leading the target" and involves anticipating both needs and solutions—up to 20 years in the future.

3. Response ACQ-3

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? Ultimately, fleet. Directly, program and program sponsor.
- Have the goals and objectives of the FNC program been explained to your community? Numerous times, but I'm not sure everyone was ever contacted.
- What impact has the FNC Process had within your community? Better continuity, less of a "food fight" for ATDs that didn't necessarily connect to programs.
- How does your community engage the FNC Process? Target programs for FNC R&D.
- How important is the FNC Process to your community/operations? Critical to some, barely understood or appreciated by others – still others regard FNC funding as money that should be theirs, but they can't direct it… that's not necessarily a bad thing.

Transitions

- Are you confident that programs will transition as planned? Many will.
- Where are the programs being transitioned to? Primarily programs of record. In some cases, the R&D being conducted is more properly 6.2, so transition is too far in the future to be tied directly to the POR, but still likely.
- What metrics are being used by the IPTs? Primarily warfighting value and likelihood of transition.
- What is the biggest obstacle to transitioning technology as planned? Underestimating the expense and scope of development required to reach program office expectations combined with overestimation by program offices of maturity of what will be delivered.
- Is there agreement on project maturity, cost and schedule? Generally, though that agreement is frequently based upon "success oriented" projections.
- Are any of the IPT products funded from multiple IPTs? Yes, for instance anti torpedo torpedo relies on a weapon and passive sensor being developed by F/FP and an active sensor being developed by LASW.
- Are any of the IPT products funded Jointly (other service or agency?) Not aware, though some products, like an improved ALE 50 towed decoy, will likely be used by Air Force as well as Navy planes.

IPT Process

- Has the IPT been effective? Largely. My perception is that it varies. Some seem to play very even handedly, while others seem to have been hijacked by the community to which the chairman belongs.
- How are decisions made in your IPT? Generally worked out at a senior manager level, then ratified by the IPT.
- How frequent has the membership changed within your IPT? Chair alone has changed 6 times in 3 years.
- How is the IPT portfolio selected? A relative ranking based on warfighting contributions, technical likelihood of success, and fiscal restraints.
- Is there a process for the selection of new programs? Yes, but that has largely developed since I have become distanced from the process.
- How many data calls have you responded in over the past year (approx)? Me, none, the IPT, many.

IPT Meetings

- Are you informed of IPT meetings? I was.
- Have you ever attended IPT meetings? I attended all.
- How frequently does your IPT meet (approx)? About quarterly, at least biannually (each leadership change).
- Do all community representatives attend IPT meetings?
  If No, which communities regularly participate? Frequently missing fleet representation.

Communication

- Are you kept informed of relevant S&T information? I was.
- Where do you go to get any needed FNC information? FNC Director.
- Is there any info you need but do not have? None that I can't get.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Never.
- What is the usefulness of the information at the S&T website? Unknown. It was always so badly out of date that I stopped using it.
- How frequently do you interact with the S&T FNC representatives? Used to meet at least monthly.

Satisfaction

- In general, are you satisfied with the FNC Process? Far better than what existed before.
- What has worked? The process, when followed.
- What has not worked? Constant cutting of FNC budget.
- What is the most important aspect of the FNC Process? Enforced planning and collaboration between FNC, acquisition program offices and acquisition sponsors.

Additional Comments

If every IPT followed the proscribed process, the FNCs would be much more highly considered than they are now. Unfortunately, some FNCs persist in pursuing the desires of individuals or of communities that feel ownership regardless of the likelihood of actual transition.

4. Response ACQ-4

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other – Actually support all levels but working group would be best guess for a single category

FNC General

- Who is the "customer" for the FNC Process? Good Question. I could speculate as to who it is but it is not clear from my involvement as to who the process framers believe is the customer.
- Have the goals and objectives of the FNC program been explained to your community? I think so.
- What impact has the FNC Process had within your community? Two main impacts. One increased hope in that more funding has filtered to items or people that normally have not benefited from ONR investments. Second extreme frustration at the continued reviews, changes in scope, budget cuts, taxes and other issues that take all of the efforts and through it away before resulting in a product. This impact is amplified when most of the efforts put forward in the early stages were completed without funding based on the future benefit that in many cases will not materialize.
- How does your community engage the FNC Process? It has varied throughout the process. At times – especially in the beginning – we were very organized with a centralized representative for our community within our FNC. As the process evolved and people changed, it has ping-ponged back and forth and sometimes both at the same time between project level direct engagement and formalized centralized organization engagement. More specifically – often there is direct engagement from the ONR program management with the acquisition representatives on an individual effort and other times the ONR-NAVAIR contact is brokered through a single individual who coordinates a NAVAIR response. The problem has been assessing when which method is correct and lead to either issues of mistrust (centralized communications) or misunderstanding of command priorities (direct project level communications).
- How important is the FNC Process to your community/operations? To my community the FNCs is extremely important since there is no other source of S&T investment for my community. The specific question of how important is the process is somewhat different in that the process does not appear to be clearly defined and articulate and as such is not understood. The result is the process is something that we endure to ensure that we can continue to maintain even the smallest of S&T investments in cost reduction and sustainment technologies.

Transitions

- Are you confident that programs will transition as planned? I am confident that most if not all projects that I am involved with will transition successfully provided the S&T produces the intended results. I am so confident that I have budgeted most transition efforts directly into my RDT&E line.
- Where are the programs being transitioned to? In the FNC that I am involved with, most efforts transition to multiple programs in a leader follower type of manner where we identify a lead platform and others that will come next. However, only a portion actually require funding beyond the FNC investment. Some projects result in a final product that can be implemented by spec or manual change. Others require integration into the weapons system and will be done using either program funding or more general RDT&E funding.
- What metrics are being used by the IPTs? Return on investment and successful transitions. ROI is for project prioritization and performed by NCCA. Transition is a measure of success of the projects themselves.
- What is the biggest obstacle to transitioning technology as planned? 1. Funding 2. funding, 3. funding. More specifically: 1. ensuring transition funding is in place. 2. preserving FNC funding in light of all of the cuts and taxes to produce the technology sound product on the timeline promised. 3. Convincing the powers that be that a spec or manual change is a viable transition path that does not require a funded budget line and that the project should not be canceled due to weak transition agreement.
- Is there agreement on project maturity, cost and schedule? Depends upon the project and the transition path. Items to transition into V-22 have different requirements than items that result in a new approved paint system for legacy aircraft.
- Are any of the IPT products funded from multiple IPTs? Not that I am aware of although we did attempt to get a project funded via multiple IPTs the other IPTs did not either care to pursue this route or have the funding to spare to do so.
- Are any of the IPT products funded Jointly (other service or agency?) In our FNC we have at least one project that is receiving funding from both the AF and the FAA.

IPT Process

- Has the IPT been effective? It depends. At times yes and at time no.
- How are decisions made in your IPT? By the chair after considering all points.
- How frequent has the membership changed within your IPT? Chair and S&T members have not changed. Acquisition is on the 3rd member.
- How is the IPT portfolio selected? If this means projects, initial selection was a process that I was a part of but would rather not discuss. Cuts are implemented from the bottom of the prioritized project list based on return on investment.
- Is there a process for the selection of new programs? One is currently in development but none exist today.
- How many data calls have you responded in over the past year (approx)? One or two. It has either slowed down or I have been pushed farther out of the loop

IPT Meetings

- Are you informed of IPT meetings? Yes
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? Every 8-10 weeks
- Do all community representatives attend IPT meetings? Yes
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? Relevant is the key word and in the eye of the sender. They believe I am, I do not believe I am.
- Where do you go to get any needed FNC information? Network of trusted agents. No centralized place for repository of information
- Is there any info you need but do not have? Would love to have a current program of record. Financial data is always hard to get and expect it will be near impossible now that N911 is no longer part of the IPT.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) what is this? Don't think I have ever used it.
- What is the usefulness of the information at the S&T website? Don't know.
- How frequently do you interact with the S&T FNC representatives? When they want something that they can only get from me. When I want something I can only get from them. Otherwise we avoid each other.

Satisfaction

- In general, are you satisfied with the FNC Process? On a scale of 1 to 10 it is a 5.
- What has worked? It has given a forum for our concerns and needs and over time our S&T reps have taken ownership of our capability area.
- What has not worked? Teamwork and communication. We continue to function with an "us and them" mentality. Believe that the IPT is viewed as an impediment that is only there to dilute ONR authority.
- What is the most important aspect of the FNC Process? It should be that all communities have a voice so that we can ensure that the S&T investment is focused in areas that will best benefit the Sailors and ensure that the transition follows the S$T investment in a timely manner. It should also be that it allows for more secure budgets of both the S&T investment and also the transition funding but I have yet to see that happen.

Additional Comments

I have noted repeatedly in my comments that communication and single focus should be the benefit of the FNC Process but I do not believe that all parties have bought into that idea and if they have not done so by now they never will. In my FNC, I continue

to see patterns repeat themselves which tells me that nothing is really changing. I had hoped that the FNCs would be a good first step in planning of projects from S&T through fielding and allow for better investment of resources but now I think it is just another flag officer good idea that has gone bad.

5. Response ACQ-5

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? fleet
- Have the goals and objectives of the FNC program been explained to your community? yes
- What impact has the FNC Process had within your community? Introduced new tech
- How does your community engage the FNC Process? Budget for transition to platforms
- How important is the FNC Process to your community/operations? minimal

Transitions

- Are you confident that programs will transition as planned? Some will
- Where are the programs being transitioned to? FA-18, E-2, others
- What metrics are being used by the IPTs? Transition or not
- What is the biggest obstacle to transitioning technology as planned? Today's requirement/budget process
- Is there agreement on project maturity, cost and schedule? Pretty much
- Are any of the IPT products funded from multiple IPTs? Not that I am aware of
- Are any of the IPT products funded Jointly (other service or agency?) ditto

IPT Process

- Has the IPT been effective? yes
- How are decisions made in your IPT? Group discussion
- How frequent has the membership changed within your IPT? annually
- How is the IPT portfolio selected? Don't know
- Is there a process for the selection of new programs? Group discussion
- How many data calls have you responded in over the past year (approx)? many, many, many

IPT Meetings

- Are you informed of IPT meetings? yes
- Have you ever attended IPT meetings? Every one
- How frequently does your IPT meet (approx)? quarterly – semi annually
- Do all community representatives attend IPT meetings? Yes, or their reps

If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? yes
- Where do you go to get any needed FNC information? ONR FNC DPM
- Is there any info you need but do not have? Not that I know of
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) rarely
- What is the usefulness of the information at the S&T website? Don't know
- How frequently do you interact with the S&T FNC representatives? weekly

Satisfaction

- In general, are you satisfied with the FNC Process? satisfied
- What has worked? Group is unified
- What has not worked? Hard to ensure transition
- What is the most important aspect of the FNC Process? Introducing new technologies

Additional Comments

6. Response ACQ-6

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other: via SURFTECH

FNC General

- Who is the "customer" for the FNC Process? Navy – Fleet, Acquisition Pgms.
- Have the goals and objectives of the FNC program been explained to your community? yes
- What impact has the FNC Process had within your community?
- How does your community engage the FNC Process? Through the IPTs, CNR & N70
- How important is the FNC Process to your community/operations? Fairly important

Transitions

- Are you confident that programs will transition as planned? no
- Where are the programs being transitioned to? Acquisition programs
- What metrics are being used by the IPTs? Signed TTAs
- What is the biggest obstacle to transitioning technology as planned? FNC funding cuts
- Is there agreement on project maturity, cost and schedule? In general, except AMRFS
- Are any of the IPT products funded from multiple IPTs? yes
- Are any of the IPT products funded Jointly (other service or agency)? KSA has an ACTD

IPT Process

- Has the IPT been effective? In the beginning
- How are decisions made in your IPT?
- How frequent has the membership changed within your IPT? 3 times
- How is the IPT portfolio selected? ONR proposes changes to flags & executes
- Is there a process for the selection of new programs? In KSA there is.
- How many data calls have you responded in over the past year (approx)? none

IPT Meetings

- Are you informed of IPT meetings? NO
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? twice a year
- Do all community representatives attend IPT meetings? No
  If No, which communities regularly participate? OPNAV

Communication

- Are you kept informed of relevant S&T information? No
- Where do you go to get any needed FNC information? Website, N70
- Is there any info you need but do not have? Yes, TTAs, etc.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Very often
- What is the usefulness of the information at the S&T website? It's OK. Often all we can get
- How frequently do you interact with the S&T FNC representatives? Depends on the FNC. KSA: once every 3 months; FFP: once a month (more frequently with POM06 process); ACES: once to twice a month

Satisfaction

- In general, are you satisfied with the FNC Process? yes
- What has worked? Getting stakeholders together
- What has not worked? Overall funding cuts
- What is the most important aspect of the FNC Process? OPNAV & Acquisition playing an important role in investment decisions

Additional Comments

7. Response ACQ-7

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other

FNC General

- Who is the "customer" for the FNC Process? Hard to say. It seems like OPNAV is who is being appeased through the IPT. But it's the Acq[uition] PM's who deliver the capability to the fleet and it's the fleet who are the end-item users.
- Have the goals and objectives of the FNC program been explained to your community? Yes
- What impact has the FNC Process had within your community? Very little.
- How does your community engage the FNC Process? Through ONR PMs, but with much difficulty.
- How important is the FNC Process to your community/operations? Not very much.

Transitions

- Are you confident that programs will transition as planned? Some will transition, probably not as planned (schedule-wise). Many will never transition due to repeated funding cuts by ONR.
- Where are the programs being transitioned to? Varies. All to current PORs.
- What metrics are being used by the IPTs? A 6.4 PE (actually any non-S&T PE). TTA's and TRL levels are also used.
- What is the biggest obstacle to transitioning technology as planned? Seemingly constant funding level changes. There is little stability.
- Is there agreement on project maturity, cost and schedule? For the approved programs, yes.
- Are any of the IPT products funded from multiple IPTs? Don't think so.
- Are any of the IPT products funded Jointly (other service or agency)? No program that I know about. Some programs have joint funds but only because its mandated. Nothing's joint by choice (look at the Navy interest in ACTD's -- nil).

IPT Process

- Has the IPT been effective? No
- How are decisions made in your IPT? Flag-level tradeoffs. The Chair makes the IPT decision.
- How frequent has the membership changed within your IPT? Lots. There's always someone new.

- How is the IPT portfolio selected? ONR submits a program and the IPT approves the program. As long as there's something there for everyone its usually ok'd.
- Is there a process for the selection of new programs? None that I have ever heard about.
- How many data calls have you responded in over the past year (approx)? Probably 3 - 4.

IPT Meetings

- Are you informed of IPT meetings? In the beginning but no longer. As I see it the meeting frequency has tapered off dramatically.
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? Not sure any longer. Possibly every 6 months.
- Do all community representatives attend IPT meetings? Most.
- If No, which communities regularly participate? I have never seen a fleet rep show up. Most meetings were dialogs between OPNAV & S&T.

Communication

- Are you kept informed of relevant S&T information? no
- Where do you go to get any needed FNC information? ONR rep's.
- Is there any info you need but do not have? Yes, the current listing of approved programs for the FNCs; new IPT EC's; new desired program directions; etc.
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Never
- What is the usefulness of the information at the S&T website? Useless. Info is old and unreliable. I have to double-check anything there that matters.
- How frequently do you interact with the S&T FNC representatives? Couple of times a month.

Satisfaction

- In general, are you satisfied with the FNC Process? No.
- What has worked? For a while there was more visibility in the Navy program and a lot of good dialog. Since the S&T program has now been defined across the FYDP the books are pretty much closed again. That level of dialog has stopped.
- What has not worked? It's still a 'good old boy' network with the old stovepipes. Not much has changed wrt getting things out the door faster. The case for the usefulness of S&T to the warfighter has not been effectively made.
- What is the most important aspect of the FNC Process? Probably opening the books to all and having the warfighting S&T dialog (years ago).

Additional Comments

It seems like the Navy tried to make some fundamental and needed changes but they seemed to mismanage it. I think they let the process get completely out of hand and it became a huge political funding food-fight within the Pentagon. Not sure why but it seems like the Navy is doing all they can to avoid using the existing SYSCOM infrastructure. It's ironic as that's probably where their biggest successes have/will come from. It's the SYSCOM ranges, labs and warfare centers that have the in-depth Systems Engineering expertise to implement solutions quickly. Disappointing.

D. FLEET/FORCE RESPONSES

1. Response FF-1

About You

- What community do you represent?

  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?

  Principal IPT / Working Group / Project level / Other :

FNC General

- Who is the "customer" for the FNC Process? Current Acquisition Programs of Record (PORs).
- Have the goals and objectives of the FNC program been explained to your community? YES
- What impact has the FNC Process had within your community? LITTLE – limited to extent Acquisition Community eventually responds to Fleet mission needs
- How does your community engage the FNC Process? POORLY. Fleet input to FNC Process limited to IPT Fleet rep, often passive rep from CFFC lacking time, TADTAR and technical background to effectively represent fleet interests. FNCs rarely solicit fleet input additional fleet input. ONR management and much FNC management does not appear to welcome any external input into FNC decisions.
- How important is the FNC Process to your community/operations? In principle, very important, since it controls half of 6.2 and most 6.3 funding. FNC Process is not having near the fleet impact it should have. Sea Trial process appears to be at least in part a reaction to 6.3 failure to serve fleet needs.

Transitions

- Are you confident that programs will transition as planned? NO. Apportionment of ONR budget reductions to FNCs seems to have little correlation to needs of either acquisition community or Fleet.
- Where are the programs being transitioned to? Existing acquisition PORs.
- What metrics are being used by the IPTs? None that affect FNC funding decisions.
- What is the biggest obstacle to transitioning technology as planned? Continual cuts in FNC funding, apparently disproportional to cuts in Navy S&T funding, and allocation of those cuts with little apparent regard for fleet priorities.

- Is there agreement on project maturity, cost and schedule? If there is, it isn't visible to Tycom N8s.
- Are any of the IPT products funded from multiple IPTs? Yes. Not necessarily bad if efforts are coordinated and complementary (e.g. REDS). An impediment to useful technology development when efforts are uncoordinated and competing for available funding (e.g. KSA and FFP phased array antenna efforts).
- Are any of the IPT products funded Jointly (other service or agency?) Don't know of any.

IPT Process

- Has the IPT been effective? Generally, no. IPTs seem to have mere figurehead role in FNC decision reviews driven by ONR FNC managers and ONR management. Fleet representation does not appear effective in most IPTs.
- How are decisions made in your IPT? Mostly by the FNC ONR staff, with no more than pro forma review by IPTs.
- How frequent has the membership changed within your IPT?
- How is the IPT portfolio selected? Mostly by the FNC ONR staff, with no more than pro forma review by IPTs.
- Is there a process for the selection of new programs?
- How many data calls have you responded in over the past year (approx)? Two invited. Several others uninvited and unwanted.

IPT Meetings

- Are you informed of IPT meetings? NO. Never. Any information I get on FNC meetings comes from SURFTECH staff or CFFC NRSA. I have repeated asked to have a consolidated calendar of FNC events maintained on the ONR web site, without effect.
- Have you ever attended IPT meetings? NO. Generally invitation only.
- How frequently does your IPT meet (approx)? They all seem to meet too infrequently to exercise effective control of FNC.
- Do all community representatives attend IPT meetings? Apparently not.
  If No, which communities regularly participate? ONR and acquisition POC PMO.

Communication

- Are you kept informed of relevant S&T information? Not very well. Some FNCs are better than others.
- Where do you go to get any needed FNC information? The DoN S&T web site. With some exceptions, the FNCs do not distribute information to me, and apparently

don't distribute information effectively beyond the ONR staff and IPT reps. KSA, LASW and OMCM are better in this respect, but none of the FNCs consistently keep stakeholders beyond the acquisition POR PMO and the IPT informed.

- Is there any info you need but do not have?
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Whenever I need information about the FNCs. With all its deficiencies it is the only source of FNC information readily available from ONR. I rely on SURFTECH, the CFFC NRSA and direct contact with ONR FNC staff for more timely/useful information.
- What is the usefulness of the information at the S&T website? Content is highly variable between FNCs. A lot of the information is obsolete. Navigation is an impediment to finding useful information even when there.
- How frequently do you interact with the S&T FNC representatives? Whenever I need current and evaluated information; averages several times a month but highly variable

Satisfaction

- In general, are you satisfied with the FNC Process? No.
- What has worked? Focusing critical mass of funding in certain areas.
- What has not worked? Responsiveness to fleet needs. Transformation. Synergy with DoD ACTD process. IPT process – decisions still too often driven by ONR and POR staff priorities vice big-Navy need priorities.
- What is the most important aspect of the FNC Process? Transitioning technology to fill highest priority gaps in fleet capabilities – not happening often enough or soon enough.

Additional Comments

For what it is worth, the rare comments I hear about ONR at flag level are to the effect that too much S&T funding still being directed to what the scientists want to work on versus what the Navy needs. I can't honestly dispute that is still happening, but feel it is unfair to blame the scientists doing the work; a fair share of the blame should be given to the managers at ONR and the acquisition PORs.

2. Response FF-2

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other (Science Advisor)

FNC General

- Who is the "customer" for the FNC Process? From our perspective, it's the fleet
- Have the goals and objectives of the FNC program been explained to your community? Yes
- What impact has the FNC Process had within your community? Gives a voice to the fleet to provide guidance to the technical community
- How does your community engage the FNC Process? Through the N8 Office at CSF
- How important is the FNC Process to your community/operations? Provides opportunity to see which technologies are likely to be available beyond the FYDP.

Transitions

- Are you confident that programs will transition as planned? No
- Where are the programs being transitioned to? They should be transitioned to the R&D offices (ex. ASTO) who plans for acquisition (backfit or forward fit)
- What metrics are being used by the IPTs? Metrics are based on the MCP assessment studies
- What is the biggest obstacle to transitioning technology as planned? Projects take longer to develop and cost more than expected
- Is there agreement on project maturity, cost and schedule? NO
- Are any of the IPT products funded from multiple IPTs? Yes
- Are any of the IPT products funded Jointly (other service or agency)? NO – if an FNC product is also an ACTD then YES

IPT Process

- Has the IPT been effective? YES
- How are decisions made in your IPT? Proposed FNC projects are discussed in the working groups, recommendations made to the executive panel and approved by the Flag Panel

- How frequent has the membership changed within your IPT? Don't know
- How is the IPT portfolio selected? Execution of FNC portfolio decided by IPT
- Is there a process for the selection of new programs? New programs are presented at SUBTECH
- How many data calls have you responded in over the past year (approx)? Too many

IPT Meetings

- Are you informed of IPT meetings? Yes
- Have you ever attended IPT meetings? Yes
- How frequently does your IPT meet (approx)? At least quarterly
- Do all community representatives attend IPT meetings? NO
- If No, which communities regularly participate? Technology developers and warfare centers

Communication

- Are you kept informed of relevant S&T information? Yes
- Where do you go to get any needed FNC information? ONR POCs
- Is there any info you need but do not have? No
- How frequently do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) Rarely
- What is the usefulness of the information at the S&T website? Used as technology resource
- How frequently do you interact with the S&T FNC representatives? Often

Satisfaction

- In general, are you satisfied with the FNC Process? NO
- What has worked? Yes sometimes
- What has not worked? Technology has not transitioned or not been accepted into acquisition
- What is the most important aspect of the FNC Process? The fact that there is a process

Additional Comments

3. Response FF-3

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other: Looking for FNC products to serve the needs of the fleet.

FNC General

- Who is the "customer" for the FNC Process? The Fleet.
- Have the goals and objectives of the FNC program been explained to your community? No – we are not well tied into the FNCs; not aware of the potential payoff.
- What impact has the FNC Process had within your community? Negligible
- How does your community engage the FNC Process? We don't – years ago the CCIs influenced the FNCs, but no real engagement since.
- How important is the FNC Process to your community/operations? Not significant

Transitions

- Are you confident that programs will transition as planned? Somewhat
- Where are the programs being transitioned to? Multiple acquisition programs
- What metrics are being used by the IPTs? Don't really know
- What is the biggest obstacle to transitioning technology as planned? End user acceptance
- Is there agreement on project maturity, cost and schedule? Don't know
- Are any of the IPT products funded from multiple IPTs? Don't know
- Are any of the IPT products funded Jointly (other service or agency)? Don't know

IPT Process

- Has the IPT been effective? Apparently some are more effective than others
- How are decisions made in your IPT? Not involved
- How frequent has the membership changed within your IPT? Not involved
- How is the IPT portfolio selected? Originally, through the CCIs
- Is there a process for the selection of new programs? This seems to be a difficulty
- How many data calls have you responded in over the past year (approx)? Zero

IPT Meetings

- Are you informed of IPT meetings? No
- Have you ever attended IPT meetings? No
- How frequently does your IPT meet (approx)? Potential interest in multiple IPTs
- Do all community representatives attend IPT meetings? Don't know
  If No, which communities regularly participate? Don't know

Communication

- Are you kept informed of relevant S&T information? No – I have to hunt for it.
- Where do you go to get any needed FNC information? To the PMs, although I haven't
- Is there any info you need but do not have? Don't know
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) I have not used it since I reported for duty at CSP 3 months ago (with the exception of Tech Solutions)
- What is the usefulness of the information at the S&T website? Useful, but not pertinent
- How frequently do you interact with the S&T FNC representatives? Haven't yet

Satisfaction

- In general, are you satisfied with the FNC Process? Don't know, but it no longer seems as responsive to the fleet as it should be
- What has worked? Initial program prioritization based on CCIs seems to have worked
- What has not worked? Program no longer agile to meet changing fleet needs
- What is should be the most important aspect of the FNC Process? Ongoing fleet input

h. Additional Comments

The fleet's time horizon is almost immediate. The FNCs look much further into the future. It seems that much up-and-coming technology is entering theater through at-sea tests and demos, but not much of this technology seems to have a tie to the FNCs. A notable example is the Assured Access experiment, which is about two-thirds Littoral ASW and one-third MCM. Thus, one would think that the two corresponding FNCs would be engaged, but I have not seen any such connection. Much state-of-the-art technology is being fielded for fleet evaluation during this and similar experiments, yet this technology does not seem tied to the FNCs, or at least the link is not apparent. There seems to be a general lack of awareness here as to what the FNCs are and how they can be of benefit to the fleet. Other technology venues seem to be making a much bigger impact. Bottom line: The FNCs no longer seem closely tied to the fleet, but in order to succeed, they should be.

4. Response FF-4

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other: S&T Advocate

FNC General

- Who is the "customer" for the FNC Process? SYSCOMs for transition, Warfighter for validation
- Have the goals and objectives of the FNC program been explained to your community? For the most part
- What impact has the FNC Process had within your community? Little impact, since no fleet demos in the past two years and no new capability was delivered, especially in the area of antisubmarine warfare. Capabilities for ASW were very expensive resulting in acquisition problems.
- How does your community engage the FNC Process? Operators involvement is too late in the development process
- How important is the FNC Process to your community/operations? Quite important to submarine community, especially related to littoral warfare

Transitions

- Are you confident that programs will transition as planned? If funding is maintained
- Where are the programs being transitioned to? SYSCOMs
- What metrics are being used by the IPTs? Not sure
- What is the biggest obstacle to transitioning technology as planned? Funding
- Is there agreement on project maturity, cost and schedule? Operators need to see capability and weight in on maturity
- Are any of the IPT products funded from multiple IPTs? Not sure
- Are any of the IPT products funded Jointly (other service or agency?) Not aware of any multi-service

IPT Process

- Has the IPT been effective? No contact was made with the submarine force (pacific region)
- How are decisions made in your IPT? Not sure
- How frequent has the membership changed within your IPT? Not sure
- How is the IPT portfolio selected? Not sure
- Is there a process for the selection of new programs? Yes, some FNCs due a RFP and complete evaluation

- How many data calls have you responded in over the past year (approx)? Only one, but it was difficult to participate while in the field

IPT Meetings

- Are you informed of IPT meetings? No
- Have you ever attended IPT meetings? No
- How frequently does your IPT meet (approx)? Not sure
- Do all community representatives attend IPT meetings? No
  If No, which communities regularly participate? Not sure

Communication

- Are you kept informed of relevant S&T information? No
- Where do you go to get any needed FNC information? ONR/NRL internal website
- Is there any info you need but do not have? Not sure
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) A lot
- What is the usefulness of the information at the S&T website? Yes
- How frequently do you interact with the S&T FNC representatives? Best POC, contacted as needed

Satisfaction

- In general, are you satisfied with the FNC Process? No, totally inflexible
- What has worked? Not sure.
- What has not worked? Poor communications with operators and Science Advisors
- What is the most important aspect of the FNC Process?

Additional Comments

Need to get products to the fleet and force for evaluation and input. Stop hiding in labs and get connected & get real!

5. Response FF-5

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / <u>Fleet Rep</u> / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / <u>Other</u>

FNC General

- Who is the "customer" for the FNC Process? <u>F/F</u>
- Have the goals and objectives of the FNC program been explained to your community? <u>yes</u>
- What impact has the FNC Process had within your community? <u>Transition: some Process: more</u>
- How does your community engage the FNC Process? <u>Before: CCIs/NRSA. Now: NRSA</u>
- How important is the FNC Process to your community/operations? <u>Depends who you ask- Overall, Scale of 1-10, 6.</u>

Transitions

- Are you confident that programs will transition as planned? <u>no</u>
- Where are the programs being transitioned to? <u>F/F</u>
- What metrics are being used by the IPTs? <u>Several I hope</u>
- What is the biggest obstacle to transitioning technology as planned? <u>Acquisition process</u>
- Is there agreement on project maturity, cost and schedule? <u>assumed</u>
- Are any of the IPT products funded from multiple IPTs? <u>should</u>
- Are any of the IPT products funded Jointly (other service or agency)? <u>should</u>

IPT Process

- Has the IPT been effective?
- How are decisions made in your IPT?
- How frequent has the membership changed within your IPT?
- How is the IPT portfolio selected?
- Is there a process for the selection of new programs?
- How many data calls have you responded in over the past year (approx)?

IPT Meetings

- Are you informed of IPT meetings?
- Have you ever attended IPT meetings?
- How frequently does your IPT meet (approx)?

- Do all community representatives attend IPT meetings?
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? Yes, believe so
- Where do you go to get any needed FNC information? PMs, labs (performers), web
- Is there any info you need but do not have? Not that I know of
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) not often enough
- What is the usefulness of the information at the S&T website? some
- How frequently do you interact with the S&T FNC representatives? ~Monthly

Satisfaction

- In general, are you satisfied with the FNC Process? yes
- What has worked? Attention to F/F needs (CCIs basis of FNC)
- What has not worked? No stability and Budget drills
- What is the most important aspect of the FNC Process? F/F benefits

Additional Comments

6. Response FF-6

About You

- What community do you represent?
  S&T / Requirements / Acquisition / Resources / Fleet Rep / Other
- In what capacity do you (or did you) support an FNC?
  Principal IPT / Working Group / Project level / Other: NONE – NO ROLE WAS EVER DEFINED FOR JFCOM WITHIN FNC PROCESS

FNC General

- Who is the "customer" for the FNC Process? Unknown; Not enough data to evaluate
- Have the goals and objectives of the FNC program been explained to your community? They were explained to me as a Science Advisor and member of the NFFTIO community. They were never, to my knowledge explained to JFCOM, be it the staff officers or the leadership team.
- What impact has the FNC Process had within your community? From what I can tell, little to none.
- How does your community engage the FNC Process? Although I asked early on (2000) and made suggestions on this, none were ever implemented. Early on, the Missile Defense FNC made contact with JFCOM to ensure that their work would be "borne joint" but that relationship, to my knowledge and despite my attempts to facilitate, was "stillborn."
- How important is the FNC Process to your community/operations? The process is not very important as it is currently defined. The products and what the FNCs are purporting to do should be very important to the joint Community – particularly in those areas of joint concern such as decision-making, C4,ISR, Missile Defense, Fires, etc.

Transitions

- Are you confident that programs will transition as planned? Unknown, no data.
- Where are the programs being transitioned to? Unknown, no data.
- What metrics are being used by the IPTs? Unknown, no data.
- What is the biggest obstacle to transitioning technology as planned? I do not know if it is the "biggest obstacle" but the fact that JFCOM was never engaged in this process could hamper implementation at a later date considering that current DoD leadership is very focused on reducing redundant service programs in favor of joint solutions (ref: MID-912, rewrites of 5000, institution of new requirements process, etc.) Perhaps it is the "biggest obstacle" after all.
- Is there agreement on project maturity, cost and schedule? Unknown, no data.
- Are any of the IPT products funded from multiple IPTs? Unknown, no data.
- Are any of the IPT products funded Jointly (other service or agency?) Unknown, no data. Be careful how you define "jointly" though. There's Multi-Service and there's Joint. Some things are best transitioned and funded by a single service (ASW, for

instance), others may have only multi-service application (fixed wing aircraft) while others such as C4ISR, Missile Defense, Fires, etc. have jointness inherent. Then there's "Inter-agency" which is increasingly becoming as important to the DoD and joint Community as "Joint"…

IPT Process

- Has the IPT been effective? Unknown, no data.
- How are decisions made in your IPT? Unknown, no data.
- How frequent has the membership changed within your IPT? Unknown, no data.
- How is the IPT portfolio selected? I attended one review of an FNC (sorry, I forget the name) but was not asked for my opinion on the IPT portfolio. I did come armed with a fleet capability need but could not get anyone to listen to me.
- Is there a process for the selection of new programs? Unknown, no data.
- How many data calls have you responded in over the past year (approx)? At JFCOM, I received no data calls related to FNCs that I can remember.

IPT Meetings

- Are you informed of IPT meetings? Not applicable
- Have you ever attended IPT meetings? No
- How frequently does your IPT meet (approx)? Not Applicable
- Do all community representatives attend IPT meetings? Unknown, not applicable
  If No, which communities regularly participate?

Communication

- Are you kept informed of relevant S&T information? No
- Where do you go to get any needed FNC information? I tried to keep up with the various websites – a lot of time there is very little in these websites except old briefings used to justify the original FNC.
- Is there any info you need but do not have? I can always ferret information (speaking as a JFCOM S&T Advisor here) and use contacts at ONR to ask questions. But after being rebuffed, I instead would go to OSD for my technology needs via ACTDs, JT&Es, DARPA. If I went to ONR, I would go in with a Naval partner (CLF, CMFL, CNSW) who shared a joint issue with me – and never did I engage an FNC to fulfill that need but instead went to NFFTIO money (Fleet/Force Innovation Program)
- How frequent do you use the DoN S&T website? (URL = https://donst.nrl.navy.mil/donst/) I perused it a few times but found it hard to navigate and a lot of the information dated.
- What is the usefulness of the information at the S&T website? When I perused it, little to none)
- How frequently do you interact with the S&T FNC representatives? Once over the three years I was Science Advisor.

Satisfaction

- In general, are you satisfied with the FNC Process? Speaking as an S&T Advisor, no.
- What has worked? Unknown
- What has not worked? Unknown
- What is the most important aspect of the FNC Process? The lack of engagement with the joint Community

Additional Comments

If this administration stays in power for another four years, I anticipate some very large changes within the service S&T communities. I heard ADM (ret) Cebrowski speak recently (at the Naval Industry Conference) and he stated that "Science and Technology that helps the joint Warfighter tends to be without a constituent" and said while he had no answers on how to fix this that either we should change the way the current system is incentivized or create a new organization to handle this. I suspect that this was not an idle comment and that very smart people in the administration and Pentagon are addressing how to solve this issue. I left behind a 5 year S&T Strategy which if implemented would go a long way to solving this. The question is whether JFCOM is really the right organization to take on this burden.

The way in which ONR has chosen to "play" in the ACTD program is also indicative of a "head in the sand" organization unwilling to accept the new rules that are forming. I would suggest that ONR consider changing the focus of some of the FNCs to Future joint Capabilities – become a leader in joint S&T by inviting the other services in (perhaps by using the TARA and associated committees) and expand their IPTs to include combatant commanders as appropriate

APPENDIX B: BUSINESS MODELS

This appendix provides additional information on classifications of business models found in the business literature. This listing is not exhaustive as there may be numerous innovative variations on the standard models presented here. In some cases sub-categories have been listed to illustrate revenue generation variations within a business model category.

- **Advertising**. This is the traditional business model used by newspapers, magazines, radio and TV. The media provides content and services mixed with advertising messages. The advertisements may be the major source of revenue for the media content provider. The media broadcaster may be a content creator or a distributor of content created elsewhere. The advertising model typically works when the volume of viewer traffic is large or highly specialized. Advertising models include:
    - **Classifieds**. Users list items for sale or wanted for purchase. Listing fees are common, but there also may be a membership fee.
    - **User Registration**. Content-based sites that are free to access but require users to register and provide demographic data. The user registration information provides useful information that can be sold to others for targeted direct advertising campaigns. Supermarket "club" membership cards are an example.
- **Affiliate**. This model provides convenient purchase opportunities wherever people may be shopping. The approach is to offer financial incentives (such as a percentage of revenue or commissions) to the affiliates. This model is also referred to as a "pay-for-performance" model because if an affiliate does not generate sales, it represents no cost to the merchant. Print media such as bookstores and newspaper use this model for the sales and distribution of their books and newspapers.
- **Brokerage**. Brokers bring buyers and sellers together and facilitate transactions (as in real estate transactions). The broker usually charges a fee or receives a commission for each transaction it enables. Broker models are appearing more frequently in business-to-business (B2B), business-to-consumer (B2C), and consumer-to-consumer (C2C) markets. Brokerage model revenue streams can include:
    - **Marketplace Exchange**. Offers services that cover the entire transaction process, from market assessment to price negotiation and order fulfillment. Exchanges can operate independently or be backed by an industry consortium.
    - **Auction Broker**. Conducts auctions for sellers. The Broker charges the seller a listing fee and commission scaled with the value of the transaction. Auctions vary widely in terms of the offering and bidding rules and are

being conducted on an experimental basis by the Navy in a number of different areas.

- **Distributor**. A catalog operation that connects a large number of product manufacturers with volume and retail buyers.
- **Virtual Marketplace**. A service for online merchants that charges setup, monthly listing, and/or transaction fees. May also provide automated transaction and marketing services.

- **Community**. This model is based on user loyalty. Users have a pre-determined level of investment in both time and emotion. Revenue stream is based on the sale of ancillary products and services or voluntary contributions.
    - **Open Source**. This model applies to software developed voluntarily by a global community of programmers who share code openly. Instead of licensing the software code for a fee, the open source model generates revenue from the sale of related services (consulting, systems integration, product support, tutorials, documentation, etc.).
    - **Public Broadcasting**. The common user contributor model used by not-for-profit radio and television broadcasting. The model receives revenue from a community of users who will support the organization through voluntary donations.
- **Direct (Manufacturer).** This model is based on a manufacturer interfacing with its customers directly and bypassing, or greatly compressing, the normal distribution channel. This model generates revenue through increased product sales at significantly lower price margins. The revenue stream for this model depends on highly efficient operations, excellent customer service, and an intimate understanding of customer preferences.
    - **Purchase.** The outright sale of a product to a consumer. Recently this definition has been expanded to clarify the right of ownership is transferred to the buyer (music industry).
    - **Lease**. The buyer receives the right to use the product under a "terms of use" agreement and a rental fee. The product is returned to the seller upon expiration or default of the lease agreement. One type of agreement may include a right of purchase upon expiration of the lease. This business model is common in the automotive and housing markets.
    - **License**. The sale of the product involves only the transfer of usage rights to the buyer and is done in accordance with a "terms of use" agreement. Ownership rights usually remain with the manufacturer. This model is common in the computer software industry.
- **Infomediary**. This model is based on revenue generated from the collection, analysis and sale of data about consumers' consumption habits.

    - **Incentive Marketing**. Provides incentives to customers such as redeemable points or coupons for making purchases from associated retailers. Revenue is generated by selling the data collected for targeted advertising.

- **Merchant**. Wholesalers and retailers of goods and services. Sales may be made based on list prices or through auction.
    - **Catalog Merchant.** Typically a mail-order business which combines mail, telephone and online ordering.
    - **Brick and Mortar**. This is a retail establishment with a traditional storefront that a customer visits.
- **Subscription**. Users are charged a periodic fee to subscribe to a service and the fees are incurred irrespective of actual usage rates.
- **Utility**. This model is also referred to as an "on-demand" model because it is based on delivering a product based on metering usage ("pay as you go"). Metered services differ from subscriber services because the revenue generated is a function of actual product usage rates. Utility models have been traditionally used for essential public services such as gas, electricity and water.
    - **Metered Usage**. Bills users based on actual usage of a service.
    - **Metered Subscriptions**. Allows subscribers to purchase access to content in metered incremental portions.

Businesses may incorporate a mixture of the above models to differentiate themselves from competitors within their industry and to optimize the potential revenue generated for their product or service offering.

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APPENDIX C: ACQUISITION TRANSITION ISSUES

This appendix discusses problems and obstacles encountered when a DoN S&T project, after having successfully completed all technical and programmatic objectives, attempted to transition the demonstrated naval capability to its target acquisition program, as originally planned. This example is included as an appendix to this thesis because it illustrates the very real issues encountered within the military "business environment" when attempting to transition advanced warfighting capabilities to operational status in our current environment.

The information presented here was compiled from a number of sources and through discussions with personnel directly involved in the technology development and transition processes. The details presented are believed to be accurate although others may have different opinions regarding my interpretation of events described.

A. INTRODUCTION

The Direct Attack Munition Affordable Seeker (DAMASK) project was a DoN S&T product improvement program (PIP) technology demonstration option for the (Joint Direct Attack Munition) JDAM program. The DAMASK project completed all of its technology development and demonstration objectives successfully yet, at the time of this writing, has failed to transition to operational capability as planned. As this example illustrates, even in cases when the (higher-risk) technology development objectives are successful, significant obstacles to achieving a "transition" remain due to inconsistencies in the interpretation of the acquisition reform guidelines established through the changes directed by SECDEF William Perry. The manner in which these acquisition guidelines are being implemented by the acquisition community, in this case, has the adverse affect of limiting the technology options. The net effect is higher weapon system costs, longer development times. In "business" terms these adverse affects would translate to a lower return on investment (ROI) and a longer time-to-market (TTM)–precisely the opposite effect of the intended goals of the acquisition reform changes. This disconnect is, of course, unintentional but is the result of an abdication of technical authority–and,

ultimately, the financial responsibility – on the part of DoN leadership in an overzealous attempt to realize costs savings without the full recognition of the consequences.

B. ISSUES

JDAM is a joint Air Force (AF) and Navy program to develop an affordable, accurate, all-weather guidance kit for current inventory 1,000 and 2,000 pound munitions (bombs). The guidance kit includes an inertial navigation system augmented by Global Positioning System (GPS) updates. The guidance kit attaches to the bomb and, through controlled tail fin movements, directs the bomb to the target. The system is an autonomous direct-attack weapon being integrated across the full spectrum of Navy and Air Force aircraft. The Mission Need Statement (MNS) is TAF/SAC 401-91 and the Operational Requirements Documents (ORD) are CAF 401-91-II-A, *Joint Adverse Weather Precision Strike Capability* (13 Nov 91) and CAF/USN ORD for JDAM (30 Aug 95). JDAM was selected as an acquisition reform model program and accelerated in FY95 as a result of a congressional study which recommended the military services develop an adverse weather, accurate, air-to-ground targeting capability as soon as possible.

1. The Acquisition Approach

JDAM was one of seven pilot programs selected by the DoD to test new and innovative methods for streamlining the acquisition process. Some of the primary goals were to incorporate, as much as possible, the use of best commercial practices and off-the-shelf components to significantly reduce the weapon system's cost and development time.

As a model DoD program, the AF established an aggressive acquisition strategy from the start. Their plans were to complete only an "acceptable" amount of Development Test & Evaluation (DT&E) and some Initial Operational Test & Evaluation (IOT&E) before the low-rate initial production (LRIP) decision would be made. The program would then complete DT&E and IOT&E prior to the Milestone III full-rate production decision. AF leadership felt this approach would provide the greatest

flexibility and allow them to accelerate program development while reducing cost, schedule and performance risks, and help ensure a smooth transition to production.

After program acceleration in 1995 the program executed its aggressive acquisition strategy in an impressive and highly successful manner. The first (JDAM) guided flight tests were conducted in October of 1996 and quickly followed by LRIP approval on 30 April 1997. This milestone accomplishment put the program into the Engineering, Manufacturing and Development (EMD) phase of the acquisition cycle. Just over one year later, on 24 June 1998, the first production JDAM guidance kit was delivered and, on 25 February 2000, the fourth LRIP contract was awarded. “Adequate” system performance test results and procurements costs for the JDAM tail kits which dropped from an initial (pre-acceleration program estimate) cost of $40K/each to just under $20K/each clearly showed the acquisition strategy was a success. JDAM's Milestone III decision by the Defense Acquisition Board (DAB) was made in early April 2001 and immediately followed by a full-rate production award for more than 11,000 JDAM guidance kits.[252]

2. Requirements Issue

Although performance was considered adequate the JDAM weapon system was not meeting the weapon system requirement which called for a 3-meter targeting accuracy. Performance was considered adequate since the baseline JDAM contract allowed for a reduced (13-meter) performance figure. In recognition of the 3-meter precision targeting shortfall discrepancy the Air Force (AF) requested the JROC[253] eliminate the "precision" requirement. The Navy, however, argued strongly for the validity of the original 3-meter requirement since this performance requirement was a critical parameter in their weapons neck-down strategy. The JROC decided in favor of the Navy and did not reduce or eliminate the original 3-meter accuracy requirement. This (revalidated) requirement provided an opportunity for the initiation of a DoN S&T project to specifically address JDAM’s 3-meter precision capability requirement.

252 The unit cost for the tail kits were just over $21K/each.

253 The Joint Requirements Oversight Council (JROC) has the responsibility to validate and approve the mission need.

3. S&T Risk Reduction Program

The contribution of the DoN's Science & Technology (S&T) Program to acquisition reform objectives is not well defined but is generally understood to include the development of advanced technology options for insertion into acquisition programs. With a validated naval requirement in hand OPNAV N78 approached the Office of Naval Research (ONR) and requested that S&T resources (budget authority categories BA1 through BA3) be used to initiate a development program which would address this high-priority (naval) weapon performance shortfall. OPNAV N78 provided transition funding and supported the development program throughout the Planning, Programming and Budgeting System (PPBS). Significant resources were POM'd over the Future Years Development Plan (FYDP) from FY99 through FY03 to pay for the development of a Precision JDAM PIP program to fill the precision requirements hole. There was agreement that the S&T program would, as a parallel effort, develop and demonstrate the 3-meter precision targeting capability to an appropriate technology readiness level (TRL) in a risk-reduction role for the JDAM program. The Direct Attack Munition Affordable Seeker (DAMASK) project was initiated as a DoN Advanced Technology Demonstration (ATD)[254] program to develop a 3-meter targeting capability for JDAM PIP. The DAMASK project successfully completed all of the ATD project objectives and demonstrated the targeting capability during operational flight tests.[255] The next step was to transition the S&T project "to the fleet" via a pre-planned Precision JDAM PIP insertion "window of opportunity." Figure 7 shows the relevant significant milestones of the baseline JDAM program as well as the DAMASK PIP candidate S&T project and the Precision JDAM PIP acquisition schedule.

254 While the DAMASK project was in development, the DoN ATD process was replaced by the FNC process. Had the DAMASK weapon system capabilities been able to successfully transition from development to the acquisition community, the DAMASK would have served as a model test case for justification of the FNC process.

255 Four live flight tests were conducted; Programmed Rounds 1 and 2 (PR1, PR2) and Guided Rounds 1 and 2 (GR1, GR2).

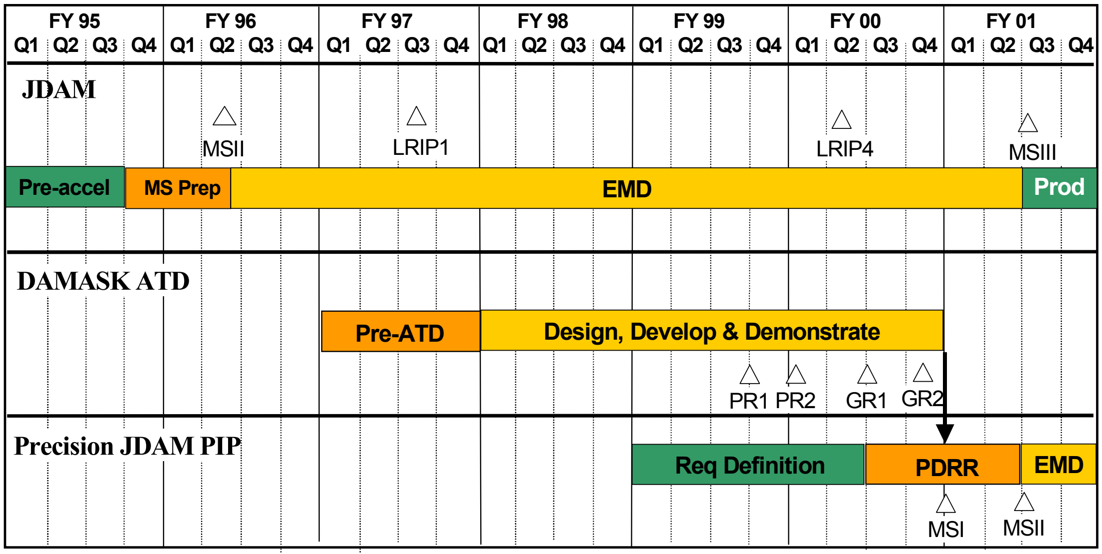

Figure 7. JDAM, Precision JDAM PIP Development Schedules

4. Transition Issues

There were no problems or concerns expressed by the any of the stakeholder communities throughout the three years the DAMASK ATD program was under development. Once the program successfully completed its ATD performance objectives – meaning it was now ready for transition to the JDAM acquisition program – a number of programmatic issues quickly surfaced.

One issue which surfaced was that the JDAM weapon was manufactured by a contractor which did not show support for transitioning the concept into the acquisition program. Although supportive during the ATD program, the contractor was not supportive of the seeker design once it became a serious candidate for Precision JDAM PIP[256]. Complicating matters was the fact that the Navy's acquisition program office expressed an opinion that, as they interpret the acquisition reform guidelines, they did not have the authority to direct a contractor to incorporate one design over any other technical approach which might be under consideration. OPNAV and ONR strongly felt that since the government had already incurred a significant investment of development

256 It is presumed the lack of prime contractor support was a direct reflection of the low profit margin for a low-cost seeker, even in production quantities.

and demonstration resources, and had demonstrated a system that successfully met the JDAM performance and cost objectives, that the DAMSK design could be directed. It was also felt that the 'new rules' of acquisition reform clearly were intended to allow the insertion of such a cost-effective warfighting capability into the JDAM program.

There was also disagreement over specific requirements which appear to have revolved around differences in the interpretation of what was "adequate" by acquisition reform standards. System performance analysis provided evidence that the DAMASK solution did not fully meet the Launch Acceptability Requirements (LAR) envelope. Accordingly, the DAMASK design was considered unacceptable by the prime contractor. To resolve the LAR requirement issue the contractor conducted a requirements study and prepared an Analysis of Alternatives (AoA) that recommended different seeker design that would meet the full performance requirements. The recommended solution was a contractor in-house design which would be considered proprietary, more expensive to produce and would take longer to develop. A final decision on these matters was never made throughout FY01.[257]

5. Current Status

The precision targeting requirement has not gone away nor has a candidate seeker been embraced for JDAM. In FY02 the funding resources were transferred from the control of a weapons acquisition program office to an aircraft acquisition program office in order to allow the Precision JDAM PIP program to continue from a different development perspective. It is now possible the JDAM precision targeting improvements will be obtained as a result of the development of an organic targeting capability for a future naval aircraft.

C. SUMMARY

As this case illustrates, serious acquisition reform issues remain and their resolution remain complex and difficult yet their resolution have far-reaching

[257] Personnel involved expressed the opinion that it appeared the program office never believed the 3-meter precision targeting requirement was necessary.

implications regarding our ability to transition our applied research and development capabilities to the operational community and achieve the acquisition reform objectives envisioned by the DoD, the DoN, and the Congress. Failure to resolve these issues has the net resultant affect of higher weapon system costs and longer development times which translate to a lower return on investment (ROI) and a longer time-to-market (TTM). In this regard the S&T resources have been, effectively, wasted and the DoN has experienced a "lost opportunity cost" equivalent to their S&T investment. These results are the antithesis of technology development and precisely the opposite of the intended goals of the DoD acquisition reform changes.

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APPENDIX D: MEASURES OF EFFECTIVENESS

This appendix presents a sampling of the metrics for organizational effectiveness uncovered during the literature search phase of the research for this thesis.

A. INPUT MEASURES

- Mission, Vision – clear, substantive, unique.
- Types and percentages of funding and applied work-years – appropriate for laboratory.
- Workload – demonstrated need for products.

1. DECISION AUTHORITY

- Technical Director/Commander tenure.
- Flexibility/freedom in decision making to operate the lab.
- Authority/control over supporting procurement, personnel, supply and maintenance organizations.
- Extent of laboratory contracting authority and reduction of mandatory reviews.
- Specific tasking/responsibilities –appropriate for laboratory.

2. PERSONNEL MANAGEMENT

- Retention rates of high grade scientist and engineers.
- Recruitment of highly-qualified scientist and engineers, both young and experienced.
- GPA at entry.
- Time to hire.
- Time to classify positions.
- Ratio of new hires from highly-rated “Top” universities.
- Ability to maintain an effective level of advanced-degree employees.
- Ratio of accepted to rejected offers.
- Number with advanced degrees.

- Number of joint efforts with academia.
- Number of recognized authorities hired.
- Number of senior S&Es hired.
- Number hired from prestigious universities.
- Number working in the Techbase.
- Number of PhDs working in the Techbase.
- Number given awards/prizes.
- Number receiving grants.
- Employee credentials – degrees, GPA, training.
- Retention rate.

3. FACILITIES MODERNIZATION

- Quality of facilities.
- Average time to effect major repairs and/or construction of new facilities.
- Ability to achieve a rate of facility replacement consistent with private-sector laboratory management practices (replacement-rate goal of 50 year cycle).

4. R&D CONTRACTING

- Improved average time to execute a contract, small purchase, or cooperative agreement while maintaining quality (Procurement Action Lead Time).
- Development of technical personnel to be more effective as contract-support coordinators.
- Reduction in required reviews, clearances, and documentation.
- Procurement acquisition lead time.
- Cost of contracting.

B. OUTPUT MEASURES

- Number of transitions to warfare systems.
- Reports/presentations – external/internal.
- New system concepts – proposed/successful.
- Proposals of all kinds – proposed/successful.
- System specifications developed.

- Systems analysis.
- Invention disclosures, patents.
- Peer review – qualitative.
- External awards (number, quality).
- Reputation among users – commendations, surveys.
- Audits – types of problems, resolved vs. unresolved.

1. LABORATORY PRODUCTIVITY

- Applications by industry for licenses of patented technologies.
- Average time to renew/acquire research equipment.
- Laboratory discretionary research and development funds (the Packard Report recommended a goal of 5% to 10% of all laboratory funding).
- Technical publications recognized by peer review.
- Operational/user interface.

2. PRODUCTS (TECHBASE)

- Number transitioned to development.
- Number transitioned to industry
- Number of patents and invention disclosures.
- Number of advanced technology demonstrations.
- Rate of growth of the number of advanced technology demonstrations.
- Number of refereed publications.
- Number of conferences and symposium presentations.

3. PRODUCTS (SYSTEMS/SUBSYSTEMS)

- Number reaching Initial Operational Capability (IOC).
- Time to reach IOC.
- Number of new starts.
- Quality judged by:
  - Peer review.
  - Customer surveys.

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APPENDIX E: CONGRESS

This appendix provides a very brief summary of the role and operation of the Congress. Congress plays an important role in the study of government operations due to their role as representatives of the American people, the taxpayers who pay for – through taxes levied – and are therefore the "customers" for the government programs.

This brief overview is included as an appendix to this thesis because it illustrates the complexity through which the revenue flows to the organizations that produce and deliver the services requested. The information presented here was compiled from a number of sources.[258]

Congress plays an important role in government business operations. Congressional treatment of R&D is characterized by fragmentation and diffusion of power. R&D programs are considered at two main levels in Congress, that of authorizations and that of appropriations. Authorizing committees (such as the House Science Committee and the Senate Committee on Health, Education, Labor, and Pensions) develop special expertise in the programs they oversee and review the substance of these programs. However, the legislation they prepare does not directly result in spending but only provides guidance and sets appropriations ceilings.

For discretionary programs, including R&D, the power to write the legislation that provides actual spending authority resides in the Appropriations Committees of the House and Senate. These committees are each divided into 13 subcommittees, each of which is responsible for a bill that controls one portion of the budget. Each subcommittee produces its appropriations bill separately from the others, and each bill is usually signed into law separately. In March 2003, Congress reorganized its appropriations structure to accommodate the new Department of Homeland Security (DHS) by creating a new subcommittee for DHS appropriations and consolidating the

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[258] AAAS Report XXVIII, *An Introduction to R&D in the FY 2004 Budget*, AAAS website URL = http://www.aaas.org/spp/rd/04pch1.htm, accessed June 2003.

Treasury/Postal and Transportation subcommittees into a single one, to keep the total number of subcommittees at 13.

R&D is contained in 10 of the 13 annual appropriations bills. Four subcommittees (Defense, VA/HUD, Labor/HHS, and Energy/Water) fund 94 percent of the total federal R&D portfolio; in each of these subcommittees, R&D funding makes up more than 15 percent of discretionary spending.

The division of the budget into 13 appropriations bills limits the extent to which it is possible to coordinate or trade off increases and decreases in agency R&D budgets in the congressional process. For example, three R&D agencies – NSF, NASA, and the Environmental Protection Agency (EPA)-come under the jurisdiction of the Subcommittee on Veterans' Affairs, Housing and Urban Development, and Independent Agencies. NIH appropriations are decided by the Labor, Health and Human Services, and Education subcommittee. This means, for example, that money used for the large increase in NIH's budget in FY 2003 did not come from the same pot of money that funds NSF and NASA. What this means is that R&D programs will compete with those non-R&D programs contained in the same appropriations bill for the limited funds available.

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